US Army Corps
of Engineers
Southwestern Division
Tulsa District

PINE BLUFF ARSENAL

SITE CLOSURE/CLEANUP PLANS

SITE 20A — DEPOT SOUTH BURNING PIT
SITE 10A — DEPOT DEMOLITIONS AND NORTH OPEN BURNING AREA
SITE 17 — PRODUCT ASSURANCE TEST RANGE AND DUMP SITE
SITE 27 — BZ POND
SITE 2 — WEBSTER ROAD TEST SITE
SITE 20B — WP SLAG DISPOSAL AREA
SITE 26 — PRODUCT ASSURANCE DROP TOWER
SITE 31A — PRODUCT ASSURANCE TEST SITE
SITE 31B — STAND BY GRENADE TEST BASIN

SUPPLEMENT NO. 1

JULY 1985

PINE BLUFF ARSENAL

Site 20A - Depot South Burning Pit (January 1984)
Site 10A - Depot Demolitions and North Open Burning Area (July 1984)
Site 17 - Product Assurance Test Range and Dump Site (September 1984)
Site 27 - B2 Pond (December 1984)
Site 2 - Webster Road Test Site (February 1985)
Site 20B - WP Slag Disposal Area (February 1985)
Site 26 - Product Assurance Drop Tower (February 1985)
Site 31A - Product Assurance Test Site (February 1985)
Site 31B - Stand by Grenade Test Basin (February 1985)

SUPPLEMENT NUMBER 1
TO
SITE CLOSURE/CLEANUP PLANS
JULY 1985

Department of the Army

Tulsa District, Corps of Engineers

Oklahoma

Introduction

This supplement has been prepared to provide updated data resulting from revised cleanup criteria and the results of contaminant investigations, waste compatibility studies, and alternative feasibility studies which were completed subsequent to submittal of the above-listed closure/cleanup plans Revisions to the indicated sections of these previously-submitted plans are documented below. Although Site 16 was also previously submitted to ADPC&E, its closure plan was not affected by these subsequent criterial study revisions due to the nature of its waste characteristics and means of closure.

III Geotechnical and Contaminant Investigations

The heavy metals cleanup criteria was revised in late February 1985, therefore, the individual site background/cleanup limits listed in these previously-submitted closure/cleanup plans have been superceded by a set of background and site cleanup limits which is identical for all sites scheduled for remedial action. A revised description and tabulation of "contamination background levels and cleanup" limits has been prepared (see Attachment 1). The attached table replaces Table 3-1 in each of the previously submitted closure plans, Site 20A, 10A, 17, 27 and a combination closure plan for Sites 2, 20B, 26, 31A and 31B In most cases, the revised cleanup limits based on Arsenal-wide background levels were less stringent than the original cleanup limits which had been based on individual site background levels

Additional contaminant investigations for total ion and EP Toxicity were completed in order to redefine the horizontal and vertical limits of contaminated material based on the revised heavy metals cleanup limits. During the course of these supplemental investigations, sufficient EP Toxicity testing was conducted on random samples from Site 17 to classify this material as non-RCRA where as it had been previously classified as RCRA based on the results of only two EP Toxicity tests. Attachment 2 contains the laboratory test reports which were completed after the original site closure plans were submitted to ADPC&E. These reports should be inserted into Appendix II of the original site closure plan reports

IV. Closure Plan

Estimated quantities of contaminated material, based on the revised cleanup limits, are listed in the table below and compared with quantities given in the original plan. Revised Plan volumes shown for off-site waste disposal plans (2, 10A, 17, 20B, 26, and 31A) include 15 percent for overexcavation and 20 percent for bulking during relocation, placement, and compaction of the contaminated material Quantities as quoted in the original closure/cleanup plans did not include these additional quantity adjustments.

Sites 2, 10A, 17, 20B, 26, and 31A - As previously submitted, the recommended closure/cleanup plans for these sites featured disposal at the proposed hazardous waste landfill. During subsequent development of the proposed Site 23A closure plan, it was determined that approximately 50,000

Estimated Quanities of Contaminated Material
(Based on Revised Cleanup Limits)

Site	Volume of Contaminated Materials (cubic yards) Original Plan	Revised Plan
2	550	350
10A	4,700	6,200
17	6,000	5,900
20A	58,000	1/
20B	3,000	2,900
26	3,000	4,800
27	10,000	1/
31A	1,500	700
31B	0	0

1/ No significant change, - in-situ closure sites.

cubic yards of suitable borrow material would be required to provide a sufficiently high profile for proper runon/runoff control associated with its on-site closure Since the contaminated material in these sites does not have RCRA waste characteristics, its disposal is not regulated by RCRA Facility construction requirements Furthermore, the results of waste compatability tests (see Attachment 3) indicated that the wastes from these sites were fully compatible with those at Site 23A and other sites being considered for disposal at Site 23A Comparative economic feasibility studies indicated that a savings of approximately $75 per cubic yard would occur if these wastes were disposed at Site 23A rather than the hazardous waste landfill due to the estimated prorata unit construction cost required to expand the landfill capacity Since the waste volumes from these six sites total 20,850 cubic yards, the cost savings from reduced landfill capacity would total $1,564,000 Consequently, the proposed closure/cleanup plans are being revised to recommend disposal as fill material in the Site 23A on-site closure cell

Dump trucks with tarpaulin-type covers would be used to haul materials over designated haul routes to Site 23A. Temporary washrack facilities would be constructed at each site to allow washdown of hauling vehicles prior to leaving the site area Also, construction equipment would be washed down prior to handling clean fill earth and prior to transportation off-site Washwater would be collected in a holding tank and transported to the Arsenal's industrial wastewater treatment plant via tanker, or directly to the industrial sewer system where available

Sites 20A and 27 - The recommended closure plans for these sites are essentially the same as previously submitted except for minor alterations in the cell configurations due to minor revisions in contaminated material boundaries The revised in-situ closure quantities are not significantly different from those previously provided ADPC&E

Other features of proposed closure/cleanup plans such as clay caps, slurry walls, grading and drainage, and facilities for erosion protection are still adequately described by the drawings and writeups previously submitted. Naturally, the Final Plan quantities and costs will be somewhat different due to the revised cleanup limits and resulting contaminated material quantities Revised drawings and cost estimates are now being developed for inclusion in the draft contract documents which will be available in late September and will then be provided to ADPC&E

Attachment No 1

3-04 Analysis

a Contamination Background Levels and Cleanup Limits - A consent agreement between the ADPCE and PBA is the basis for this remedial action This agreement is based on Arkansas law which prohibits pollution of Arkansas waters but does not identify contaminants or allowable limits Through discussions and letters, the ADPCE identified parameters and concentrations of concern as follows

(1) Heavy Metals

(a) Total ion concentrations The maximum contaminant level (MCL) for the 8 heavy metals listed in RCRA (40 CFR 261 24) were set at 10 times the background levels. "Arsenal-wide" background levels were calculated as the mean of 102 samples collected at uncontaminated areas near 17 of the sites

(b) EP toxicity concentrations. In addition to meeting the MCL for the total ion method, the ADPCE also required that the samples not exceed one-tenth the regulatory values shown in RCRA (40 CFR 261.24) when analyzed using EP methodology. Table 3-1 lists background levels and MCL's (cleanup limits) for these heavy metals

TABLE 3-1
HEAVY METAL BACKGROUND LEVELS AND CLEANUP LIMITS

Contaminant	Background mean (mg/kg)	Site Cleanup Limits: Total Ion MCL (mg/kg)	Site Cleanup Limits: EP Toxicity MCL (mg/l)
Arsenic (As)	1.30	13 0	0.50
Barium (Ba)	28.70	290 0	10.00
Cadmium (Cd)	< 0 50 1/	5.0	0 10
Chromium (Cr)	<5.00	50 0	0.50
Lead (Pb)	7 55	75 5	0.50
Mercury (Hg)	<0 10	1 0	0.02
Selenium (Se)	0 18	1 8	0.10
Silver (Ag)	<0 50	5.0	0.50
Zinc (Zn)	8 50	2/	2/

1/ < = less than

2/ Background level for Zinc was determined since it is a common constituent of demilitarized ordnance wastes Zinc is not an RCRA-listed contaminant, therefore, cleanup limits were not required by ADPCE

(2) Organics - A GC-mass-spectrometer scan was conducted on samples from those sites where there is evidence of disposal of organic compounds At those sites where the tests revealed the presence of compounds listed in RCRA (40 CFR 261 33), an individual determination of the hazard of the substance was made This was dependent on the compounds and the amount present in the sample This determination was used to develop the recommended closure plan and is subject to approval of the ADPCE. No testing for the organic compounds found at the site was performed on the soil samples from the background hole. The organics of primary concern are not naturally occurring and should not be present in any concentration in the soil

Attachment No 2

Supplemental

Laboratory, Chemistry and Soils Reports

SITE 2

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13761-7 **(2 pages)**

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 2	**Contract No..**
TEST REQUEST NO.: Telephone **Dated:** 20 March 85 **Received.**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL. Soil
No. and type of samples. 4 Jars
Source or other identification. Borings, 2,10,13,17

Date received: 30 March, 28 June 1984

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 2 April 85.

Report sent to: Tulsa District Office	**Copy furnished:**

Date: 23 Apr 85	**Name and title:** **ARTHUR H. PERSH** **Director** **SWD Laboratory**	**Signature**

SWDED-GL Report 13761-7

Table 1

Pine Bluff Arsenal
Site 2

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
2-2	J-1	5799	0 0-0 9	<0.01	<0 001	<0 50	0 023	<0.01	0 0014	0 99	<0.0004
10	J-2	5828	1 0-1 7	<0 01	<0 001	0 59	0 060	<0 01	<0 0001	0 04	<0 0004
13	J-1	6926	0 0-1 2	<0.01	0 012	<0 50	0 007	<0 01	<0 0001	0.06	<0 0004
17	J-1	6943	0 0-1 0	<0 01	<0.001	<0.50	0.010	<0 01	0 0002	0 10	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13761-8 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 2	**Contract No.**
TEST REQUEST NO Telephone **Dated** 3 Apr 84 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 3 jars
Source or other identification Holes 2,11 and 12

Date received 30 Mar, 28 Jun 84

REMARKS

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 10 May 85

Report sent to. Tulsa District Office	**Copy furnished**

Date. 14 May 85	**Name and title** WILLIAM R TANNER Assistant Director SWD Laboratory	**Signature** William R Tanner

SWD FORM 696
8 SEP 77

SWDED-GL Report 13761-8 Table Pine Bluff Arsenal Site2

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
2	J-2	5800	0 9-1 9	<0 01	<0 001	<0 50	0 005	<0 01	0 0001	0 03	<0 0004
2-11	J-1	6918	0 0-1 0	<0 01	0 001	<0 50	0 005	<0 01	0 0001	0 05	<0 0004
12	J-1	6922	0 0-1 0	<0 01	<0 001	<0 50	0 005	<0 01	0 0001	0 06	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l.

SITE 10A

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13678-5 **(** 2 **pages)**

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 10A	**Contract No.:**
TEST REQUEST NO.: Telephone **Dated.** 20 March 85 **Received.**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL. Soil
No. and type of samples. 13 Jars
Source or other identification. Borings, 3,4,7,8,9,10,12,14,32,34,35, 38.

Date received. 24&28 October, 23 November, 5 December 1983

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 27 March 85

Report sent to: Tulsa District Office	**Copy furnished.**

Date:	**Name and title:**	**Signature**
23 Apr 85	**ARTHUR H. VERSE** **Director** **SWD Laboratory**	

SWD FORM 886
8 SEP 77

SWDED-GL Report 13678-5

Table 1

Pine Bluff Arsenal
Site 10A

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
10A-3	J-3	4250	1 0-2.0	<0.01	0 002	<0 50	0 008	<0 01	0 0001	0 06	<0 0004
4	J-1	4264	0 0-1.0	<0.01	<0.001	0 95	0 007	<0 01	0.0001	0 07	<0 0004
7	J-1	4355	0 0-1 0	<0 01	0 003	<0.50	0 038	<0 01	<0.0001	0.05	<0.0004
8	J-1	4373	0.0-1.0	<0 01	0 001	<0 50	0 008	<0 01	0 0001	0 03	<0 0004
9	J-2	4408	1 0-2 0	<0.01	<0.001	<0 50	0 008	<0 01	0.0001	0.05	<0 0004
10	J-1	4410	0 4-1 0	<0.01	<0 001	<0.50	0.005	<0.01	0 0002	0 02	<0 0004
12	J-2	4417	1.0-3.0	<0 01	<0.001	<0.50	0 008	<0 01	0.0017	0 13	<0.0004
14	J-1	4422	3 0-4 0	<0 01	0.002	<0 50	0 008	<0 01	0 0001	0.07	<0 0004
32	J-1	4514	0 0-1 0	0.01	0 005	<0 50	0 010	<0 01	0.0001	0 18	<0 0004
34	J-1	4529	0 0-1.0	<0 01	0 003	0.50	0 008	<0 01	0 0001	0.08	<0 0004
34	J-2	4530	1 0-2.0	<0 01	<0 001	<0.50	0.008	<0 01	0 0002	0.99	<0.0004
35	J-1	4493	0 0-1 0	<0 01	0.129	<0 50	0 040	<0 01	0.0001	0 25	<0 0004
38	J-3	4534	7.0-8 0	<0 01	<0 001	<0.50	0.018	<0 01	<0.0001	0 04	<0.0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/1

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13678-6 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 10	**Contract No**

TEST REQUEST NO.: Telephone **Dated** 1 APr 85 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 1 jar
Source or other identification
Site 10, Hole 34

Date received 5 Dec 83

REMARKS

Results of Tests of Soil for EP Toxicity

Report sent to. Tulsa District Office	**Copy furnished**

Date	**Name and title**	**Signature**
29 May 85	WILLIAM R TANNER Assistant Director SWD Laboratory	Wm R Tanner

SWD FORM 898
8 SEP 77

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
10-34	J-3	4531	2 0-3 0							0 05	
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SITE 17

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13706-10 **(2 pages)**

PROJECT Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 17	**Contract No..**
TEST REQUEST NO. Telephone **Dated** 12 Dec 84 **Received.**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 13 soil samples
Source or other identification. Holes 50, 51 and 52

Date received 7 Dec 84

REMARKS.

Results of Chemical Analysis of Soil Samples Table 1

Results of tests telephoned to TDO on 4 Jan 85

Report sent to. Tulsa District Office	**Copy furnished:**

Date. 10 Jan 85	**Name and title:** **ARTHUR H FEESE** **Director** **SWD Laboratory**	**Signature**

SWD FORM 896
8 SEP 77

Results of Chemical Analysis of Soil[1]

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
17-50	J-1	8278	0 0- 2 0				40	23		530			
	J-2	8279	2 0- 5 0				1 0	< 5 0		31			
	J-3	8280	5 0- 8 0				0 5	< 5 0		4 9			
	J-4	8281	8 0- 9 5				< 0 5	< 5 0		9 9			
17-51	J-1	8282	0 0- 1 0				12	8 0		890			
	J-2	8283	1 0- 3 0				< 0 5	< 5 0		6 9			
	J-3	8284	3 0- 5 0				0 6	< 5 0		4 9			
	J-4	8285	5 0- 7 5				< 0 5	< 5 0		7 0			
	J-5	8286	7 5- 7 5				< 0 5	< 5 0		7 1			
17-52	J-1	8287	0 0- 2 0				< 0 5	< 5 0		7 7			
	J-2	8288	2 0- 5 0				< 0 5	< 5 0		9 2			
	J-3	8289	5 0- 8 0				< 0 5	< 5 0		11			
	J-4	8290	8 0-10 0				< 0 5	< 5 0		7 1			
Minimum reported concentration				0 5	1 0	20 0	0 5	5 0	0 1	1 0	0 1	1 0	

(1) Results reported in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13706-11 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 17	**Contract No.**
TEST REQUEST NO., Telephone **Dated** 1 Apr 85 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 3 jars
Source or other identification
Site 17, hole 4, 7 and 14

Date received 5 Mar 84

REMARKS

Results of Tests of Soil for EP Toxicity

Results of tests telephoned to TDO on 10 May 85

Report sent to Tulsa District Office	**Copy furnished**

Date	**Name and title**	**Signature**
29 May 85	WILLIAM R TANNER Assistant Director SWD Laboratory	W R Tanner

SWD FORM 896
8 SEP 77

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
17- 4	J-2	5170	1 0-2 0				0 020			0 21	
17- 7	J-3	5196	2 0-3 0				0 100			0 35	
17-14	J-3	5238	2 0-3 0				0 040			0 04	
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/1

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13706-11 **(** 2 **pages)**

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 17	**Contract No..**
TEST REQUEST NO.. Telephone **Dated.** 15 Jan 85 **Received:**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No. and type of samples 10 jars
Source or other identification. Holes 4,5,8,11,14,35,36,41 and 44

Date received. 5 Mar 84, 28 Mar 84

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 29, 30 Jan 85

Report sent to. Tulsa District Office	**Copy furnished.**

Date: 19 Feb 85	**Name and title:** **ARTHUR H FEESE** **Director** **SWD Laboratory**	**Signature**

SWD FORM 806
8 SEP 77

Table 1

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
4	2	5170	1 0-2 0			0 50	0 013	0 01		0 17	
5	1	5179	0 0-1 0			0 50	0 090	0 03		0 24	
8	5	5208	4 0-5 0			0 75	0 013	0 02		0 17	
11	4	5227	3 0-4 0			0 50	0 023	0 05		0 21	
14	3	5238	2 0-3 0			0 50	0 043	0 04		0 19	
35	1	5715	0 0-0 5			0 50	0 005	0 01		0 07	
36	2	6787	0 7-2 0			0 50	0 045	0 04		0 69	
	3	6788	2 0-3 0			0 50	0 023	0 02		0 25	
41	3	6809	1 3-3 0			0 84	0 093	0 01		0 65	
44	1	6818	0 0-1 0			0 50	0 015	0 01		0 36	
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13706-12 **(** 2 **pages)**

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 17	**Contract No..**
TEST REQUEST NO.. Telephone **Dated.** 20 March 1985 **Received.**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No. and type of samples 11 Jars
Source or other identification. Borings, 4,7,8,14,34,38,40,41,42,44

Date received. 5 & 8 March 84, 4 June 84

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 29 March 85

Report sent to: Tulsa District Office	**Copy furnished.**

Date: 23 Apr 85	**Name and title:** **ARTHUR H. FEESE** **Director** **SWD Laboratory**	**Signature**

SWD FORM 886
8 SEP 77

Table 1

Pine Bluff Arsenal
Site 17

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
17- 4	J-1	5169	0.0-1.0	<0 01	<0 001	2 06	0 070	<0 01	<0 0001	0 79	<0 0004
7	J-2	5195	1 0-2 0	<0 01	<0 001	0 59	0 158	<0 01	<0 0001	0 25	<0 0004
8	J-3	5206	2 0-3 0	<0 01	0 004	<0 50	0 025	<0 01	<0 0001	0 08	<0 0004
14	J-2	5237	1 0-2 0	<0 01	<0 001	<0 50	0 178	<0 01	<0.0001	0 06	<0 0004
34	J-2	5712	1.2-2 0	<0 01	<0.001	<0 50	0 025	<0 01	<0 0001	0 05	<0 0004
38	J-2	6795	0 3-1 3	<0 01	0.002	<0 50	0 018	<0 01	<0 0001	0 02	<0 0004
40	J-3	6805	2.2-3 3	<0 01	0 003	<0 50	0 075	<0 01	<0 0001	0 04	<0.0004
41	J-4	6810	3 0-5 0	<0 01	0.001	<0 50	0 008	<0 01	<0 0001	0 03	<0 0004
42	J-1	6811	0 0-1 8	<0 01	0 001	<0 50	0 068	<0 01	<0 0001	0 05	<0 0004
42	J-2	6812	1 8-3.0	<0.01	<0 001	<0 50	0 007	<0 01	<0 0001	0.18	<0 0004
44	J-1	6818	0 0-1 0	<0 01	0 003	<0 50	0 005	<0.01	<0 0001	0 07	<0 0004

Minimum Reported Concentration	0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits	5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SITE 20A

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13657-7 (9 pages)

PROJECT Pine Bluff Arsenal **Feature** Site 20A	**Contract No**

TEST REQUEST NO Telephone **Dated** 10 Jan 84 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Disturbed and Undisturbed Soil Samples
No and type of samples 13 Jars and 1 Denison sample
Source or other identification Borings 26, 27, 28, 29, and 48

Date received 5 Dec 83, 4, 9 Jan 84

REMARKS

Results of Physical Tests	Table 1
Results of Chemical Analysis	Table 2
Gradation Curves	Plates 1-6

Advance data on chemical analyses telephoned TD on 20 Jan 84

Report sent to	**Copy furnished**
Tulsa District	

Date	**Name and title**	**Signature**
8 March 1984	ARTHUR H FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77

Results of Tests of Disturbed and Undisturbed Soil Samples

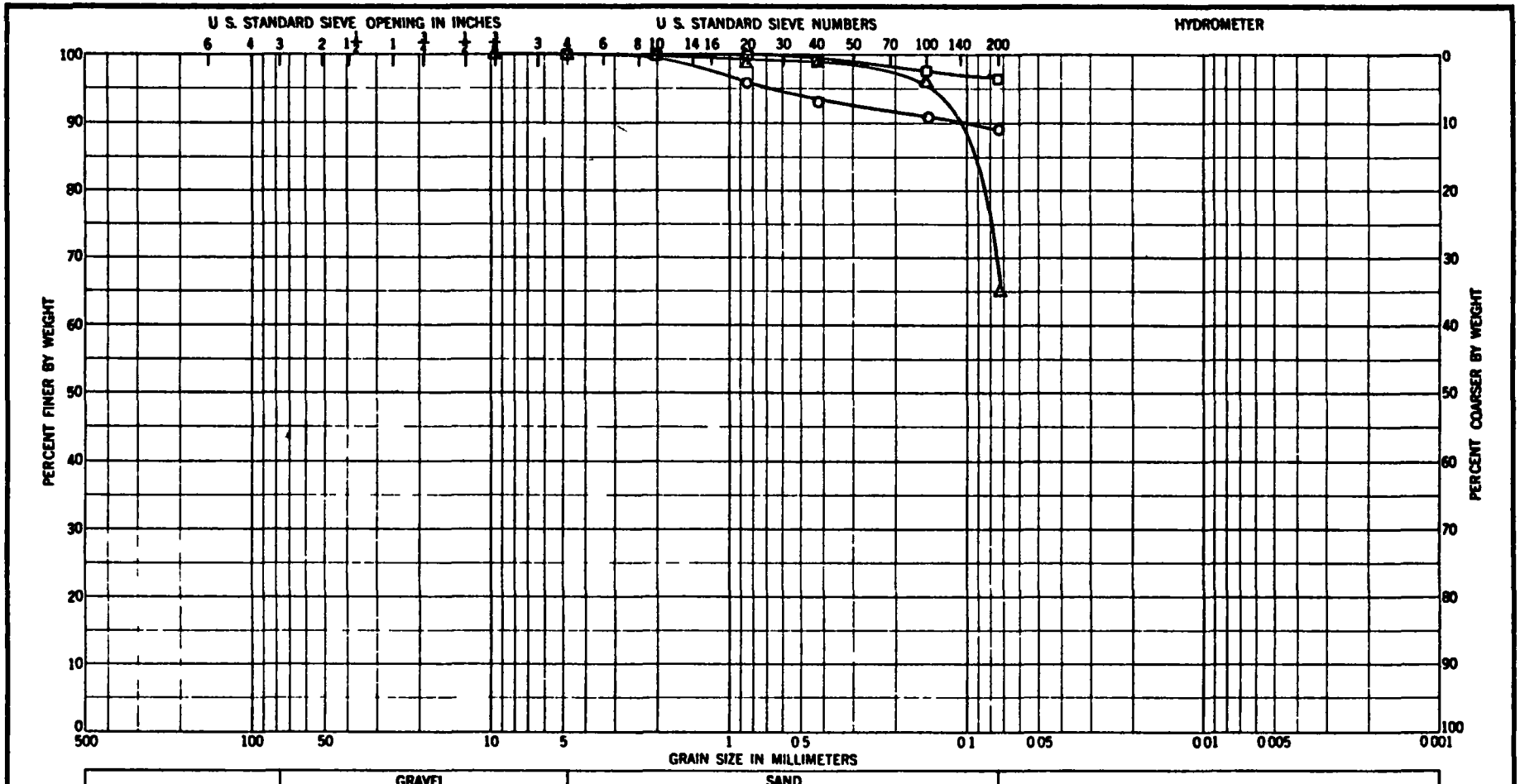
Boring No	Field No	SWD No	Depth ft	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %	Dry Density lb/cu ft		Description
20A-26	J-3	G-4472	4 0-6 0	0	11	89	54	21	33		45 0		CH	CLAY, brown, moist
	J-5	G-4474	9 0-12 0	0	35	65	NP	NP	NP		32 9		ML	SILT, sandy, brown, wet, free water
	J-7	G-4476	7 0- ?	0	3	97	37	19	18		37 4		CL	CLAY, brown, very moist
20A-27	J-1	G-4714	0 0- 2 3	0	11	89	58	23	35		36 0		CH	CLAY, brown, moist
	J-3	G-4716	5.2- 7 4	0	5	95	NP	NP	NP		28 1		ML	SILT, gray, wet, free water
	J-4	G-4717	7 4- 9 2	0	7	93	34	17	17		38 9		CL	CLAY, dark brown, moist
20A-28	J-1	G-4723	0 0- 2 0	0	1	99	49	20	29		35 5		CL	CLAY, dark brown, moist
	J-2	G-4724	2 0- 5 0	0	26	74	NP	NP	NP		26 4		ML	SILT, sandy, brown, moist
	J-4	G-4726	6 0- 9 0	0	8	92	43	19	24		31 7		CL	CLAY, brown, moist
20A-29	J-1	G-4731	0 0- 2 0	0	3	97	71	30	41		41 2		CH	CLAY, dark brown, moist, small roots throughout sample
	J-3	G-4733	6 0- 7 0	0	9	91	34	18	16		39 3		CL	CLAY, brown, very moist
	J-4	G-4734	7 5- 9 0	0	8	92	30	19	11		36 4		CL	CLAY, brown, very moist
	J-6	G-4736	10 0-12 0	0	33	67	NP	NP	NP		29 3		ML	SILT, sandy, brown, wet
20A-48	DB-1	84/35	15 5-17 0	22	8	70	60	23	37		46 8	74	CH	CLAY, gravelly, brown, very moist, soft, pieces of wood and metal up to 2" x 4", more sandy on one side

Vertical Falling Head Permeability = 2 6 x 10^{-8} cm/sec
Specific Gravity = 2 73

Table 2

Results of Chemical Analysis of Soils

SWD Lab No	Site Hole	Jar No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphate
4714	20A-27	1	0 0- 2 3							18 0		91	
4715	20A-27	2	2 3- 5 2							6 0		16	
4723	20A-28	1	0 0- 2 0							16		83	
4724	20A-28	2	2 0- 5 0							11		37	
4731	20A-29	1	0 0- 2 0							33		360	
4732	20A-29	2	2 0- 6 0							7 9		30	
83-3797	20A-25	7	8 5-12 5							140		10,000	
83-3798	20A-25	8	12 5-15 0							22		230	



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
G/4472 ○	4 0-6 0	CLAY (CH)	45 0	54	21	33
G/4474 △	9.0-12.0	SILT,sandy (ML)	32 9	NP	NP	NP
G/4476 □	7 0-?	CLAY (CL)	37 4	37	19	18

GRADATION CURVES

Project Pine Bluff Arsenal

Area

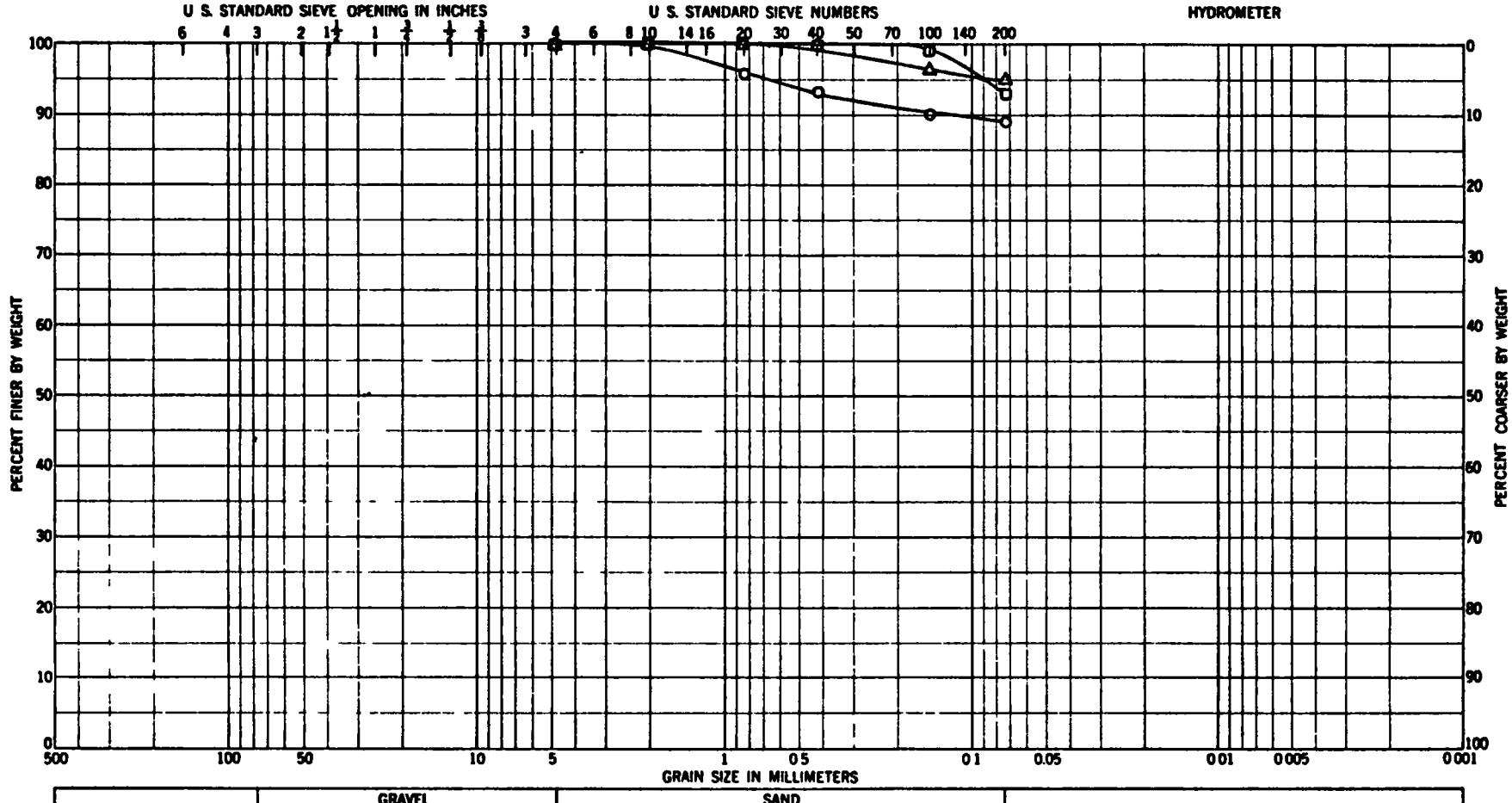
Boring No 20A-26

Date Feb 84

Plate 1

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-4714 o	0 0-2 3	CLAY (CH)	36 0	58	23	35
G-4716 Δ	5 2-7 4	SILT (ML)	28 1	NP	NP	NP
G-4717 □	7 4-9 2	CLAY (CL)	38 9	34	17	17

GRADATION CURVES

Project Pine Bluff Arsenal

Area

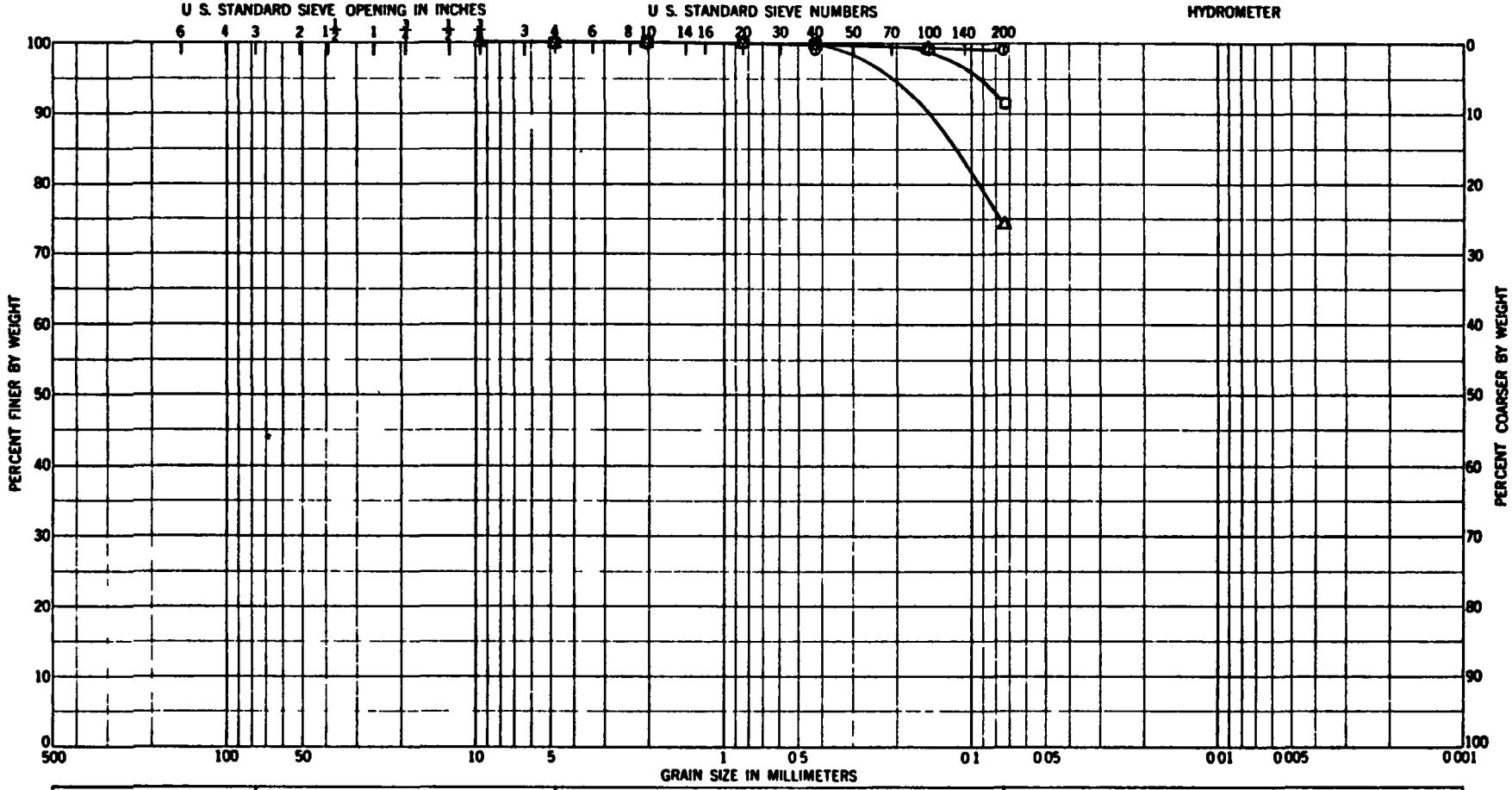
Boring No. 20A-27

Date Feb 84

Plate 2

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
G/4723 ○	0 0-2 0	CLAY (CL)	35 5	49	20	29
G/4724 △	2 0-5 0	SILT, sandy (ML)	26 4	NP	NP	NP
G/4726 □	6 0-9 0	CLAY (CL)	31.7	43	19	24

GRADATION CURVES

Project Pine Bluff Arsenal

Area

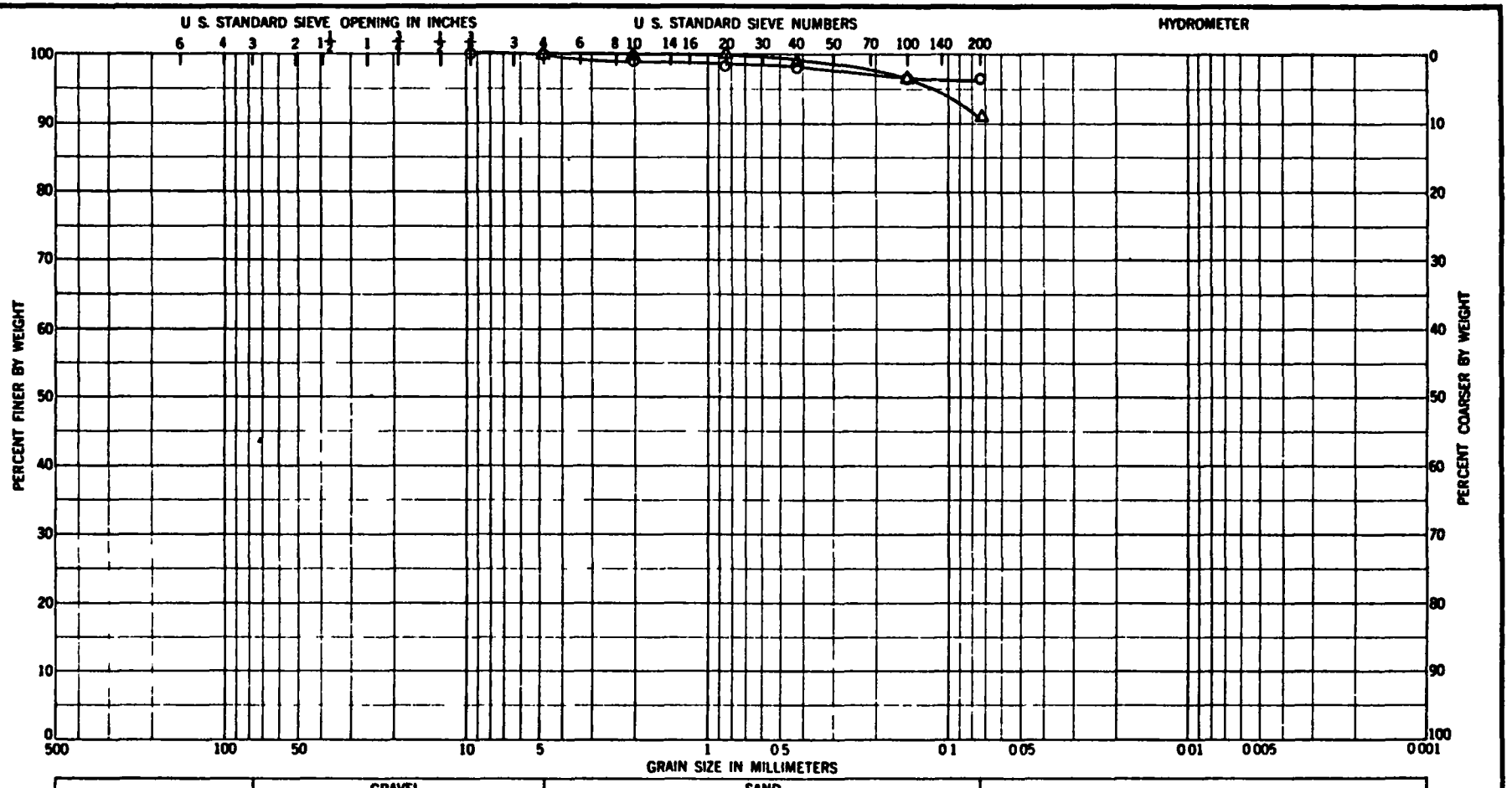
Boring No. 20A-28

Date Feb 84

Plate 3

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
G/4731 o	0 0-2 0	CLAY (CH)	41 2	71	30	41
G/4733 Δ	6 0-7 0	CLAY (CL)	39 3	34	18	16

GRADATION CURVES

Project Pine Bluff Arsenal

Area

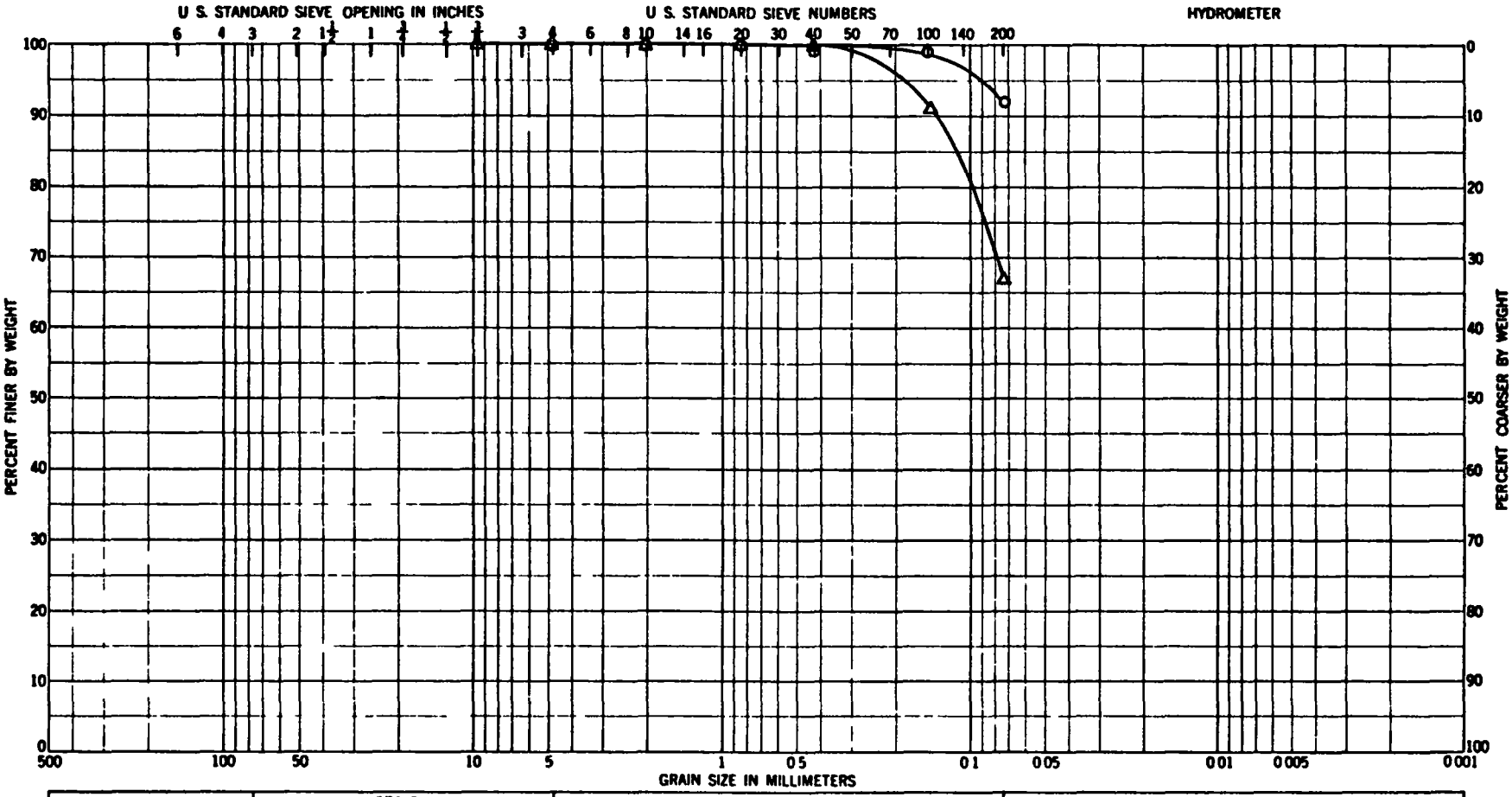
Boring No. 20A-29

Date Feb 84

Plate 4

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
G/4734 O	7 5-9 0	CLAY (CL)	36 4	30	19	11
G/4736 Δ	10 0-12 0	SILT, sandy (ML)	29 3	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

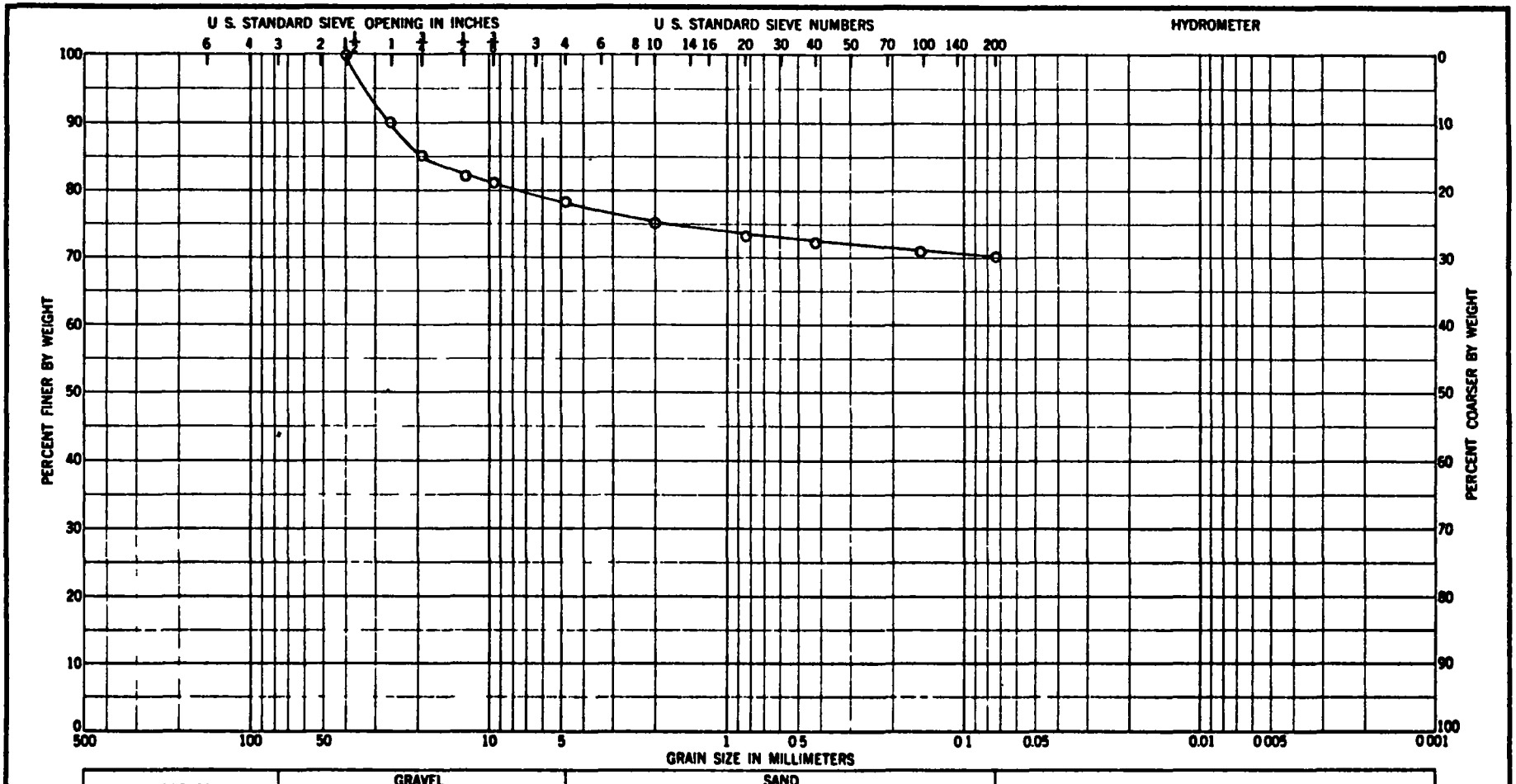
Boring No 20A-29

Date Feb 84

Plate 5

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
84/35 O	15.5-17.0	CLAY, gravelly (CH)	46 8	60	23	37

Project Pine Bluff Arsenal

Area

Boring No. 20A-48

Date Feb 84

GRADATION CURVES

Plate 6

SWDED-GL Report No 13657-7

ENG FORM 1 MAY 63 2087

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13657-8 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Site 20	**Contract No**
TEST REQUEST NO MIL 84-36 & -40 **Dated** **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples
Source or other identification

Date received

REMARKS

Values listed on the following page were telephoned to TD personnel in October and November 1983, but were inadvertently omitted from the typed reports It is suggested that the values be transferred to the referenced reports

Report sent to	**Copy furnished**
Tulsa District	

Date	**Name and title**	**Signature**
1 Feb 84	ARTHUR H FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77

Results of Tests of Soil for Lead and Zinc[1]
(Omitted from Previous Reports)

SWD Lab No	Hole	Sample	Depth	Pb	Zn
			SWDED-GL Report 13657-1 (25 Oct 83)		
G-3889	7	1	0 0- 3 0	3 6	15 9
90	"	2	3 0- 6 0	14 0	35 3
91	"	3	6 0- 9 0	2 0	17 1
92	"	4	9 0-12 0	10 5	26 2
G-3893	8	1	0 0- 3 0	5 6	22 7
94	"	2	3 0- 6 0	10 7	20 8
95	"	3	6 0- 9 0	5 2	15 1
96	"	4	9 0-12 0	7 5	10 8

Note Chromium concentrations tabulated in the typed report are correct
Telephoned values of "<10" should be disregarded

			SWDED-GL Report 13657-2 (18 Nov 83)		
G-4096	22	7	9 0-12 0	10 0	31 4
97	"	8	12 0-15 0	5 7	18 2

(1) Results are in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13657-9 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site	**Contract No**
TEST REQUEST NO.. Telephone **Dated** 12 Apr 85 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Water
No and type of samples 1 jar
Source or other identification lagoon
Site 20A

Date received 12 Apr 85

REMARKS

Results of Chemical Analysis of Water Samples Table 1

Results of tests telephoned to TDO on 10 May 85

Report sent to. Tulsa District Office	**Copy furnished**

Date	**Name and title**	**Signature**
28 May 85	WILLIAM R TANNER Assistant Director SWD Laboratory	William R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report 13657-9

Table 1

Pine Bluff Arsenal
Site 20A

Results of Chemical Analysis of Water(1)

Hole	Field No	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
20A	J-1	9055		<0 01	<0 001	<0 50	0 005	0 01	0 0001	0 10	0 0006		
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004	0 01	

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13657-10 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 20A	**Contract No.**

TEST REQUEST NO. Telephone **Dated** 20 Mar 85 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No. and type of samples 7 jars
Source or other identification
Site 20A, holes 1, 9, 10, 18, 22, 23 , 25

Date received 4 Oct, 7 Oct, 11 Oct 83

REMARKS

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 22 Apr 85

Report sent to. Tulsa District Office	**Copy furnished**

Date	**Name and title**	**Signature**
29 May 85	WILLIAM R TANNER Assistant Director SWD Laboratory	

SWD FORM 896
8 SEP 77

Table 1

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
1	J-1	3783	0 0-3 0	<0 01	0 002	<0 50	0 008	<0 01	0 0001	0 06	<0 0004
9	J-1	3903	0 4-3 4	<0 01	0 002	< 50	0 008	<0 01	0 0002	0 05	<0 0004
10	J-1	3916	0 0-2 8	<0 01	0 002	<0 50	0 008	<0 01	0 0001	0 08	<0 0004
18	J-4	4032	3 0-3 5	<0 01	0 005	<0 50	0 020	0 01	0 0001	0 08	<0 0004
22	J-1	4090	0 0-0 5	<0 01	0 004	7 2	0 008	0 01	<0 0001	0 14	0 0007
23	J-1	4106	0 0-1 0	<0 01	0 001	0 95	0 005	0 02	<0 0001	0 10	<0 0004
25	J-7	83-3797		<0 01	0 001	2 1	0 133	0 01	0 0001	0 25	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13657-11 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 20A	**Contract No.**

TEST REQUEST NO.: Telephone **Dated** 25 April 1985 **Received.**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 1 Jar
Source or other identification Site 20A, hole 25

Date received. 29 November 1983

REMARKS

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 17 May 1985

Report sent to. Tulsa District Office	**Copy furnished.**

Date.	**Name and title**	**Signature**
06 Jun 85	WILLIAM R TANNER Assistant Director SWD Laboratory	Wm R Tanner

SWD FORM 806
8 SEP 77

SWDED-GL Report 13657-

Table 1

Pine Bluff Arsenal
Site 20A

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
20A-25	J-8	83-3798	12 0-15 0	0 04	< 0.001	3.67	0.013	0.03	< 0 0001	0 04	< 0.0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/1

SITE 20B

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13779-10 (2 pages)

PROJECT. Pine Bluff Arsenal **Feature:** Close Hazardous Waste Site 20B	**Contract No.:**
TEST REQUEST NO.. Telephone **Dated.** 20 March 85 **Received:**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL. Soil
No. and type of samples. 9 Jars
Source or other identification: Borings, 1,2,3,5,8,13,18,19

Date received: 20 April, 25 May and 27 July 1984.

REMARKS:

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 2 April 85

Report sent to: Tulsa District Office	**Copy furnished:**

Date: 23 Apr 85	**Name and title:** ARTHUR H. PERSE Director SWD Laboratory	**Signature**

SWD FORM 806
8 SEP 77

SWDED-GL Report 13779-10

Table 1

Pine Bluff Arsenal
Site 20B

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
20B-1	J-2	6369	0.8-1 8	<0 01	0.001	<0.50	0.005	<0.01	<0 0001	0 05	<0.0004
2	J-4	6375	3 5-5.0	<0 01	0.015	<0.50	0 005	<0.01	<0 0001	0 04	<0 0004
3	J-1	6377	0.0-1.0	<0 01	0.002	<0 50	0 003	<0.01	<0 0001	0 03	<0 0004
3	J-2	6378	1 0-2.0	<0.01	0.012	<0 50	0 003	<0 01	<0 0001	0 03	<0 0004
5	J-1	6388	0.0-1.0	<0 01	0.010	<0 50	0 005	<0.01	<0 0001	0 04	<0 0004
8	J-1	6404	0 0-1.0	<0 01	0.002	<0.50	0 005	<0.01	<0 0001	0.05	<0 0004
13	J-1	6764	0.0-1.0	<0 01	0.002	<0 50	0 005	<0 01	<0.0001	0 04	<0 0004
18	J-1	7290	0.0-0 6	<0 01	0.004	<0.50	0 007	<0 01	<0 0001	0 02	<0 0004
19	J-2	7295	1 0-2 0	<0.01	0 006	<0 50	0 005	<0 01	<0 0001	0 05	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SITE 26

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13782-7 (2 pages)

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 26	**Contract No..**
TEST REQUEST NO.. Telephone **Dated.** 20 March 85 **Received.**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL. Soil
No. and type of samples. 8 Jars
Source or other identification. Borings, 1,2,7,8,9,13,16,19.

Date received: 20 April and 5 July 1984

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 4 April 85

Report sent to: Tulsa District Office	**Copy furnished.**

Date: 23 Apr 85	**Name and title:** ARTHUR H. VERSE Director SWD Laboratory	**Signature**

8 SEP 77

Table 1

Pine Bluff Arsenal
Site 26

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
26-1	J-1	6410	0 0-1 0	<0 01	<0.001	1 63	0 005	0 03	<0 0001	0 63	<0 0004
2	J-4	6418	3.5-6.5	<0 01	<0.001	0.56	0.008	<0 01	<0 0001	0 05	0 0010
7	J-1	6453	0 0-1.0	<0 01	<0 001	1 01	0 005	<0 01	<0 0001	0 05	0 0005
8	J-4	6461	3.5-6.5	<0 01	0 002	0 88	0 010	<0 01	<0 0001	0 05	0 0007
9	J-3	7027	1 2-2.2	<0 01	<0 001	0 59	<0 001	0 01	<0 0001	0 02	<0 0004
13	J-1	7046	0.0-1.2	<0.01	0 002	<0 50	0.003	<0 01	<0 0001	0 04	<0 0004
16	J-1	7061	0 0-1 0	<0 01	<0 001	2.05	0 013	0 05	<0 0001	0 04	<0.0004
19	J-1	7076	0 0-1 0	<0 01	<0 001	3 41	0 008	<0 01	<0 0001	0 15	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13782-8 (2 pages)

PROJECT. Pine Bluff Arsenal **Feature.** Close Hazardous Waste Site 26	**Contract No.:**
TEST REQUEST NO.. Telephone **Dated.** 10 April 1985 **Received.**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No. and type of samples. 1 Jar
Source or other identification Site 26, hole 1.

Date received 20 April 1985

REMARKS.
Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 17 May 1985

Report sent to. Tulsa District Office	**Copy furnished.**

Date. 06 Jun 85	**Name and title.** WILLIAM R TANNER Assistant Director SWD Laboratory	**Signature** Wm R Tanner

) FORM
8 SEP 77

SWDED-GL Report 13782

Table 1

Pine Bluff Arsenal
Site 26

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
26-1	J-2	6411	1.0-2.0	<0 01	<0 001	<0 50	0 005	<0.01	<0.0001	0.04	<0.0004

Minimum Reported Concentration	0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits	5 0	5 0	100 0	1.0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SITE 27

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13741-19 (4 pages)

PROJECT Pine Bluff Arsenal Feature Closed Hazardous Waste Site 27	Contract No
TEST REQUEST NO Verbal Request Dated 12 Mar 85 Received	From Chief Geotechnical Branch Tulsa District

MATERIAL Undisturbed Soil Samples
No and type of samples 2 Denison samples
Source or other identification Boring 48

Date received 11 Mar 85

REMARKS

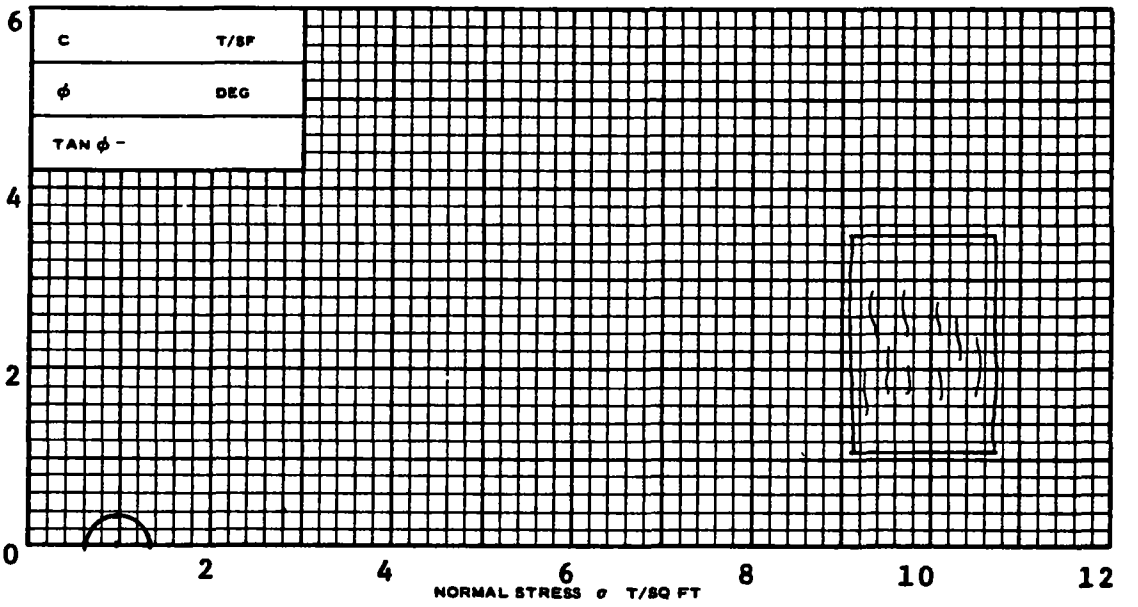
Results of Tests — Table 1
Triaxial Compression Tests, 1 point, Q-type — Plates 1-2

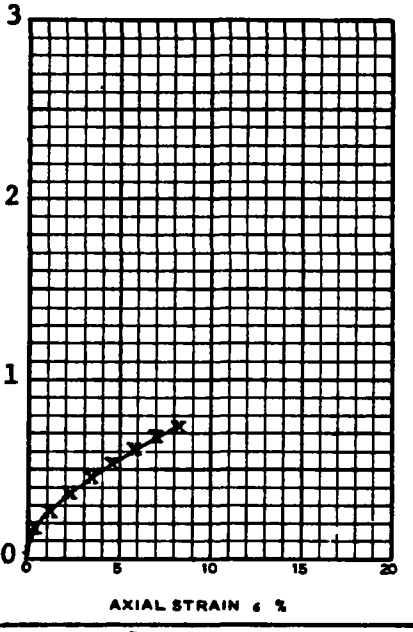
Advance data sent 23 Mar 85

Report sent to	Copy furnished
Tulsa District	

Date	Name and title	Signature
27 Mar 85	ARTHUR H FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77





SPECIMEN NO						
INITIAL	WATER CONTENT %	w_o	19.9			
	DRY DENSITY LB/ CU FT	γ_{d_o}	102			
	SATURATION %	S_o	87			
	VOID RATIO	e_o	.606			
BEFORE SHEAR	WATER CONTENT %	w_c				
	DRY DENSITY LB, CU FT	γ_{d_c}				
	SATURATION %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE T/SQ FT	u_o				
MINOR PRINCIPAL STRESS T/SQ FT		σ_3	.6			
MAXIMUM DEVIATOR STRESS T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.75			
TIME TO $(\sigma_1 - \sigma_3)_M$ MIN		t_f	4			
ULTIMATE DEVIATOR STRESS, T SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER IN.		D_o	5.5			
INITIAL HEIGHT IN		H_o	8 9			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS SILT (ML)

LL	PL	PI	G_s	TYPE OF SPECIMEN	TYPE OF TEST
20	18	2	2.64	Undist.	Q

REMARKS

PROJECT Pine Bluff Arsenal

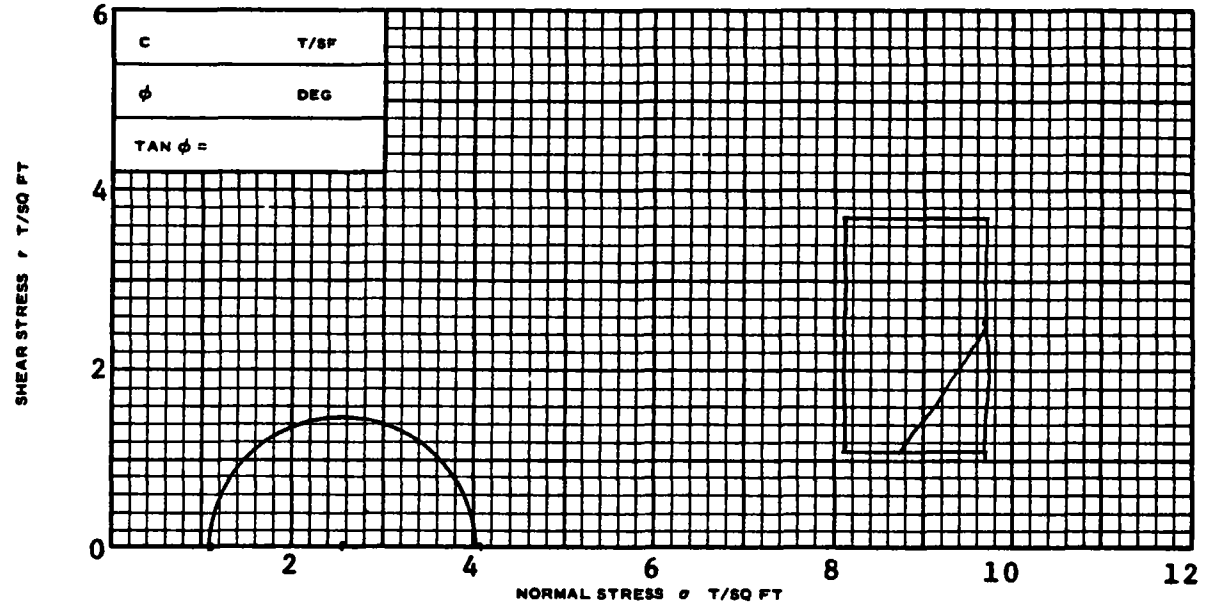
BORING NO 48 SAMPLE NO 85/1231

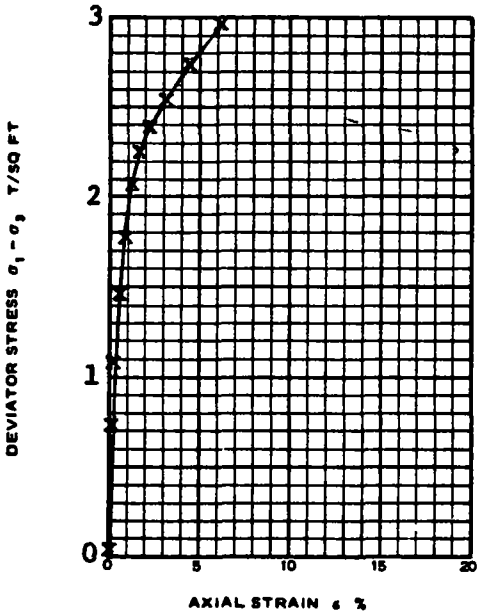
DEPTH/ELEV 7 5-9 5

LABORATORY SWD DATE Mar 85

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE





SPECIMEN NO						
INITIAL	WATER CONTENT %	w_o	20.3			
	DRY DENSITY LB/ CU FT	γ_{d_o}	107			
	SATURATION %	S_o	98			
	VOID RATIO	e_o	.546			
BEFORE SHEAR	WATER CONTENT %	w_c				
	DRY DENSITY LB CU FT	γ_{d_c}				
	SATURATION %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE T/SQ FT	u_b				
MINOR PRINCIPAL STRESS T/SQ FT		σ_3	1.1			
MAXIMUM DEVIATOR STRESS T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.94			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$ MIN		t_f	9			
ULTIMATE DEVIATOR STRESS, T SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER IN		D_o	5.4			
INITIAL HEIGHT IN		H_o	9.2			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS LEAN CLAY (CL)

LL	PL	PI	G_s	TYPE OF SPECIMEN	TYPE OF TEST
37	14	23	2.66	Undist.	Q

REMARKS

PROJECT Pine Bluff Arsenal

BORING NO 48 SAMPLE NO 85/1233

DEPTH/ELEV 16 5-18 0

LABORATORY SWD DATE Mar 85

TRIAXIAL COMPRESSION TEST REPORT

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PINE BLUFF ARSENAL CLOSED HAZARDOUS WASTE SITE 27

BORING NO	FLD NO	SWD NO	DEPTH, FT	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
48	DB 3	85/1231	7 5-9 5				20	18	2		19 9	102	T-Q (1 PT)	ML - SILT, GRAY, MOIST TO VERY MOIST, SOME ROOTS NOTED, WETTER IN UPPER PORTION OF SAMPLE
48	DB 5	85/1233	16 5-18 0				37	14	23		20 3	107	T-Q (1 PT)	CL - LEAN CLAY, GRAY BROWN, MOIST, HARD, SOME FINE SAND NOTED

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13741-21 (2 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 27	**Contract No.**

TEST REQUEST NO.. Telephone **Dated** 25 April 1985 **Received.**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No. and type of samples 16 Jars
Source or other identification.
Site 27, holes 14,16,24,28,29,37,40,45,46,47,48 and 49

Date received· 2 May, 8 August, 19 September, 19 November, 20 February and 21 February 1984

REMARKS

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 17 May 1985

Report sent to. Tulsa District Office	**Copy furnished.**

Date.	**Name and title**	**Signature**
06 Jun 85	WILLIAM R TANNER Assistant Director SWD Laboratory	Wm R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report 13741

Table 1

Pine Bluff Arsenal
Site 27

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
27-14	J-1	6578	0.0-1 0	< 0 01	< 0.001	< 0 50	0 005	< 0.01	< 0 0001	0 01	< 0 0004
16	J-1	6787	0 0-1.0	< 0 01	< 0 001	< 0 50	0 008	0 14	< 0.0001	0 08	< 0 0004
24	J-1	6909	0.0-1 0	< 0 01	< 0 001	2.7	0 008	2 7	< 0 0001	0 02	< 0 0004
28	J-9	7326	14.0-15 5	< 0.01	< 0.001	< 0.50	0.005	< 0 01	< 0.0001	0 01	< 0 0004
29	J-1	7333	0.0-1 0	< 0.01	< 0 001	< 0 50	< 0 005	< 0 01	< 0 0001	0.01	< 0 0004
29	J-9	7341	13.0-16 0	< 0.01	< 0 001	< 0 50	0 005	< 0 01	< 0.0001	0 09	< 0 0004
37	J-5	7656	6.0-9.0	< 0.01	< 0.001	< 0 50	0.010	< 0.01	< 0.0001	0.02	< 0.0004
40	J-6	8131	16.9-18 9	< 0.01	< 0.001	< 0 50	0.005	< 0 01	< 0.0001	0 01	< 0 0004
45	J-4	8698	6 0-9.0	< 0.01	< 0 001	< 0 50	0 008	< 0 01	< 0 0001	0 02	< 0.0004
45	J-7	8701	12 0-13.0	< 0.01	< 0.001	< 0 50	0 003	< 0.01	< 0.0001	0.03	< 0 0004
46	J-1	8523	0.0-2.0	< 0 01	< 0 001	< 0 50	0.003	< 0.01	< 0.0001	0 01	< 0.0004
46	J-5	8527	9.0-12.0	< 0 01	< 0 001	< 0 50	0 003	< 0.01	< 0.0001	0 03	< 0 0004
47	J-8	8713	12 0-13.0	< 0.01	< 0.001	< 0 50	0.003	< 0.01	< 0.0001	0.02	< 0.0004
48	J-1	8532	2.0-2.5	< 0.01	< 0 001	< 0 50	0.005	< 0.01	< 0 0001	0.02	< 0 0004
48	J-5	8536	12 0-12 5	< 0.01	< 0.001	3.8	0.003	< 0 01	< 0.0001	0.02	< 0 0004
49	J-5	8723	10 5-12.5	< 0.01	< 0 001	< 0 50	0.005	< 0 01	< 0.0001	0.02	< 0.0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13741-22 (7 pages)

PROJECT Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 27	**Contract No.**
TEST REQUEST NO.: Telephone **Dated** 12 March 1985 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 1 Jar
Source or other identification Site 27, hole 48

Date received 11 March 1985

REMARKS

Results of Chemical Analysis of Soil Samples	Table 1
Determination of Priority Pollutants	Table 2
Photograph	Plate 1

Results of tests telephoned to TDO on 15 March 1985

Report sent to. Tulsa District Office	**Copy furnished.**

Date.	**Name and title**	**Signature**
	WILLIAM R TANNER Assistant Director SWD Laboratory	Wm R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report 13741 -22

Table 1

Pine Bluff Arsenal Site

Results of Chemical Analysis of Soil[1]

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Zn	Total Organic Carbon	Fe
27-48	DB-4	85-1232	10 0-12.0			99				5 3	22	280	10,000
Minimum reported concentration				0 5	1 0	20 0	0 5	5 0	0 1	1 0	1 0		10

(1) Results reported in mg/kg

TABLE 2

ALLIED ANALYTICAL & RESEARCH LABORATORIES INC
CHEMISTS
CONSULTANTS & TECHNOLOGISTS
2636 WALNUT HILL LANE SUITE 350 DALLAS TEXAS 75229 214/352 8311

April 2, 1985

REPORT OF ANALYSIS

NUMBER.	A-1216
CLIENT.	Mr. Jeff Tye Southwestern Division Laboratory U.S. Army Corps of Engineers 4815 Cass Street Dallas, Texas 75235
DESCRIPTION.	The client submitted one soil sample for determination for priority pollutants.
PROCEDURE.	The sample was analyzed using GC/MS. The U.S.E.P.A. Method 8040 was followed for the analysis.
RESULTS	See attached data sheets.
QUALITY CONTROL STATEMENT	The analysis was performed in duplicate. The average surrogate recover was 95.0%.

Submitted by

ALLIED ANALYTICAL & RESEARCH LABORATORIES

Steve T. Jones, Senior Chemist

STJ/kb

TABLE 2 (cont'd)

ALLIED ANALYTICAL & RESEARCH LABORATORIES INC
CHEMISTS
CONSULTANTS & TECHNOLOGISTS
2636 WALNUT HILL LANE SUITE 350 DALLAS TEXAS 75229 214/352 8311

April 3, 1985

SAMPLE Soil

DATE SUBMITTED 3/19/85

IDENTIFYING MARKS none

ANALYTICAL REPORT NO. A1216

SUBMITTED BY

Southwestern Div Lab
U S Army Corps of Engineers
Attn Jeff Tye

ADDRESS 4815 Cass Street
Dallas, TX 75235

ANALYSIS

U S E P A Method 8040
ACID EXTRACTABLES

COMPOUND	MDL,ppb	Conc ,ppb
2-Chlorophenol	5	NA
Phenol	5	NA
2,4 Dichlorophenol	5	NA
2-Nitrophenol	10	NA
p-Chloro-m-Cresol	5	NA
2,4,6 Trichlorophenol	5	NA
2,4 Dimethylphenol	5	NA
2,4 Dinitrophenol	75	NA
2-Methyl-4,6 Dinitrophenol	50	NA
4-Nitrophenol	5	NA
Pentachlorophenol	10	NA

ALLIED ANALYTICAL & RESEARCH LABORATORIES, INC BY _____

TABLE 2 (cont'd)

ALLIED ANALYTICAL & RESEARCH LABORATORIES INC
CHEMISTS
CONSULTANTS & TECHNOLOGISTS
2636 WALNUT HILL LANE SUITE 350 DALLAS TEXAS 75229 214/352 8311

April 3, 1985

SAMPLE Soil

DATE SUBMITTED 3/19/85

IDENTIFYING MARKS None

ANALYTICAL REPORT NO. A1216

SUBMITTED BY

Southwestern Div Lab
U S Army Corps of Engineers
Attn Jeff Tye

ADDRESS 4815 Cass Street
Dallas, TX 75235

ANALYSIS

Base-Neutral Extractables

U S E P A Method 8040

COMPOUND	MDL,ppb	Conc ,ppb
Antharacene	2	NA
Dimethyl Phthalate	2	NA
Diethyl Phthalate	22	NA
Fluoranthene	2	NA
Pyrene	2	NA
Di-n-butyl Phthalate	2	NA
Benzidene	30	NA
Butyl Benzyl Phthalate	3	NA
Chrysene	3	NA
Bis (2-ethylhexyl) Phthalate	3	NA
Benzo (a) anthracene	8	NA
Benzo (b) fluoranthene	5	NA
Benzo (k) fluoranthene	3	NA
Benzo (a) pyrene	3	NA
Indeno (1,2,3-cd) Pyrene	4	NA
Dibenzo (a,h) anthracene	3	NA
Benzo (g,h,i) perylene	4	NA
n-Nitrosodimethylamine	2	NA
n-Nitrosodi-n-propylamine	2	NA
4-Chlorophenyl phenyl ether	4	NA
3, 3' Dichlorobenzidine	17	NA
2, 3, 7, 8 TCDD	31	NA
Bis (chloromethyl) ether	6	NA
Di-n-octyl Phthalate	3	NA

NA = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES INC BY _____

TABLE 2 (cont'd)

ALLIED ANALYTICAL & RESEARCH LABORATORIES INC
CHEMISTS
CONSULTANTS & TECHNOLOGISTS
2636 WALNUT HILL LANE SUITE 350 DALLAS TEXAS 75229 214/352 8311

April 3, 1985

SAMPLE Soil

DATE SUBMITTED 3/19/85

IDENTIFYING MARKS none

ANALYTICAL REPORT NO. A1216

SUBMITTED BY

Southwestern Division Laboratory
U S Army Corps of Engineers
Attn Jeff Tye

ADDRESS 4815 Cass Street
Dallas, TX 75235

ANALYSIS

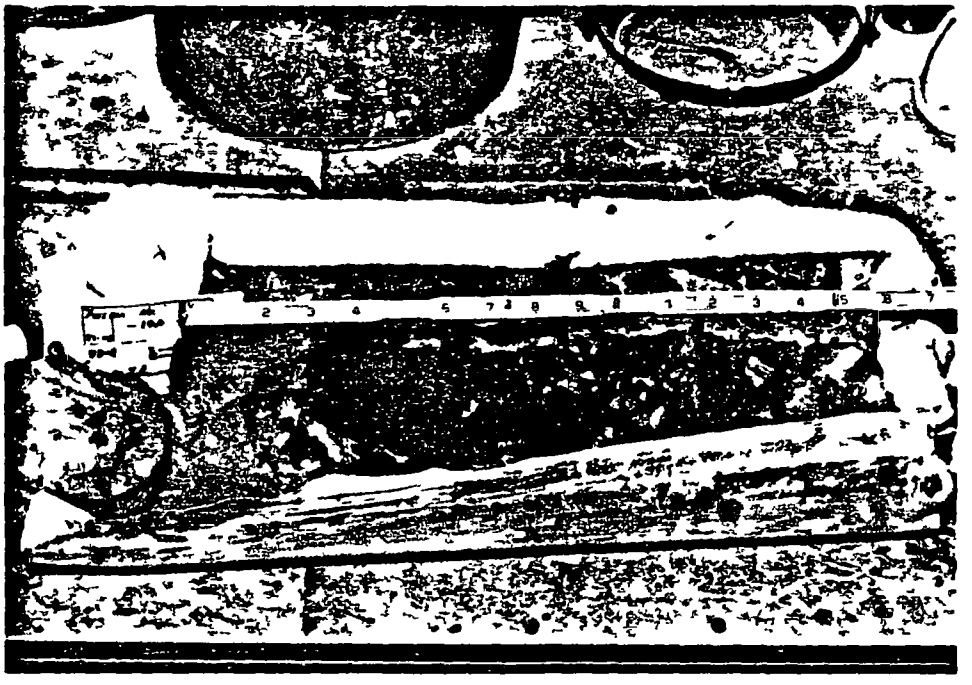
Base-Neutral Extractables

U S E P A Method 8040

COMPOUND	MDL,ppb	CONC ,ppb
1, 3 Dichlorobenzene	2	NA
1, 4 Dichlorobenzene	4	NA
Hexachloroethane	2	NA
1, 2 Dichlorobenzene	2	NA
Bis (2-chloroisopropyl) ether	6	NA
Hexachlorobutadiene	2	NA
1, 2, 4 Trichlorobenzene	2	NA
Naphthalene	2	NA
Bis (2-chloroethyl) ether	2	NA
Hexachlorocyclopentadiene	2	NA
Nitrobenzene	2	NA
Bis (2-chloroethoxy) Methane	5	NA
2-Chloronaphthalene	2	NA
Acenaphthylene	4	NA
Acenaphthene	2	NA
Isophorone	2	NA
Fluorene	2	NA
2, 6 Dinitrotoluene	2	NA
1, 2 Diphenylhydrazine	2	NA
2, 4 Dinitrotoluene	6	NA
n-Nitrosodiphenylamine	2	NA
Hexachlorobenzene	2	NA
4-Bromophenyl Phenyl Ether	2	NA
Phenanthrene	2	NA

NA = Below minimum detectable level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, INC BY _____



Site 27 Hole 48
DB-4
Sample 85-1232
Depth 10'-12'

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13741-23 (2 pages)

PROJECT. Pine Bluff Arsenal **Feature** Close Hazardous Waste Site 27	**Contract No..**

TEST REQUEST NO.. Telephone **Dated** 3 April 1985 **Received**	**From** Chief Geotechnical Branch Tulsa District

MATERIAL Soil
No and type of samples 18 Jars
Source or other identification
Site 27, holes 44 thru 49.

Date received 20 and 21 February 1985.

REMARKS
Results of Chemical Analysis of Soil Samples Table 1

Results of tests telephoned to TDO on 17 May 1985.

Report sent to Tulsa District	**Copy furnished.**

Date. 06 Jun 85	**Name and title** WILLIAM R TANNER Assistant Director SWD Laboratory	**Signature** William R Tanner

SWD FORM 896
8 SEP 77

Results of Chemical Analysis of Soil[1]

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
27-44	J-3	8687	6.0-9.0			< 20	< 0.5	< 5 0		1 4			
	J-5	8689	11.0-12.0			27	< 0 5	< 5.0		2.3			
	J-7	8691	15.0-16.0			24	< 0 5	< 5 0		4.2			
27-45	J-4	8698	6.0-9.0			< 20	< 0.5	< 5.0		3.8			
	J-5	8699	9 0-11.0			45	< 0.5	< 5 0		3.6			
	J-7	8701	12.0-13.0			160	< 0.5	< 5.0		1.7			
27-46	J-4	8526	6.0-9.0			25	< 0.5	15		6.2			
	J-5	8527	9.0-12.0			77	< 0.5	< 5 0		3 2			
	J-6	8528	15.0-18.0			420	< 0.5	7 3		5.6			
27-47	J-7	8712	11.0-12.0			20	< 0.5	7.1		9 8			
	J-8	8713	12.0-13 0			150	< 0.5	< 5.0		5.5			
	J-9	8714	13.0-15.0			< 20	< 0.5	6.3		6.0			
27-48	J-4	8535	9.5-10.0			41	< 0 5	< 5.0		7 6			
	J-5	8536	12.0-12.5			440	< 0.5	< 5.0		2.2			
	J-6	8537	12.5-15.3			99	< 0 5	< 5.0		3.1			
27-49	J-4	8722	7.5-10.5			33	< 0.5	6.3		8 4			
	J-5	8723	10.5-12 5			24	< 0.5	8.1		6 6			
	J-6	8724	12.5-14.5			< 20	< 0.5	< 5.0		6.7			
Minimum reported concentration				0.5	1.0	20.0	0.5	5.0	0.1	1 0	0.1	1 0	

(1) Results reported in mg/kg

SITE 31

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13780-7 **(2 pages)**

PROJECT. Pine Bluff Arsenal **Feature:** Close Hazardous Waste Site 31	**Contract No..**
TEST REQUEST NO.. Telephone **Dated.** 20 March 85 **Received.**	**From.** Chief Geotechnical Branch Tulsa District

MATERIAL. Soil
No. and type of samples. 8 Jars
Source or other identification. Borings 6 thru 12.

Date received. 23 April, 5 July 1984

REMARKS.

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 4 & 5 April 1985

Report sent to: Tulsa District Office	**Copy furnished.**

Date: 23 Apr 85	**Name and title:** **ARTHUR H. PERSE** **Director** **SWD Laboratory**	**Signature**

SWD FORM
8 SEP 77

Table 1

Pine Bluff Arsenal
Site 31

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
31-6	J-1	6485	0 0-1.0	<0 01	<0 001	<0 50	0 023	<0 01	<0 0001	0 11	<0 0004
7	J-1	6500	0 0-1.0	<0 01	<0 001	<0 50	0 362	0 01	<0 0001	0 09	<0 0004
7	J-2	6501	1.0-2 0	<0 01	<0.001	<0 50	0.020	<0 01	<0 0001	0 04	<0 0004
8	J-2	6506	0 4-1 4	<0 01	<0 001	<0.50	0 010	<0.01	<0.0001	0 03	<0 0004
9	J-2	6512	0 2-1.2	<0 01	<0 001	<0 50	0 007	<0 01	<0 0001	0 03	<0 0004
10	J-1	6519	0.0-1.0	<0 01	<0 001	<0 50	0 008	<0 01	<0 0001	0 02	<0 0004
11	J-1	7104	0.0-1 0	<0 01	<0 001	<0 50	0.005	<0 01	<0 0001	0 05	<0 0004
12	J-1	7108	0 0-1 0	<0 01	<0 001	<0 50	0 003	0.02	<0 0001	0 23	<0 0004

Minimum Reported Concentration	0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits	5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

Attachment No 3

Attachment No 3

27 Mar 85

Results of Compatibility Tests Conducted on PBA Wastes

1 Compatibility tests were performed on waste samples from Pine Bluff Arsenal sites 2, 10A, 17, 20B, 23A, 26, 31, and 34 Test methods followed those proposed by Graves et al (Atch 1) Samples selected for testing had previously been shown to have high total metals content

2 None of the samples exhibited organic vapor, explosive, flammability, combustibility or water reactivity hazards None of the samples exhibited oxidation potential and the pH of the samples would allow mixing of the samples Results of the test are attached (Atch 2)

3 In summary, any of the samples may be mixed with any of the other samples without increasing present risk

Richard G Hunter

2 Atch

RICHARD G HUNTER
Environmental Specialist
Tulsa District Office
U S Army Corps of Engineers

P.S. Compatibility tests were later conducted on waste samples from sites 12 and 29 Following test methods given in Attachment #1. These supplemental test results indicated that wastes from Site 12 and the South Area of Site 29, which has non-RCRA characteristics, are full compatible with the wastes from the other sites listed in Paragraph #1. Although the wastes from Site 34 are compatible, they will be disposed in the hazardous waste landfill since they contain certain RCRA-listed organic compounds

James A Horn

James A Horn
Environmental Engineer
Tulsa District Office
U S Army Corps of Engineers

PART 2

CHEMICAL CHARACTERIZATION AND BENCH-SCALE COMPOSITING OF HAZARDOUS MATERIALS FOR DISPOSAL CONSIDERATIONS

NATHAN A. GRAVES
THOMAS L. JOHNSON
Tetra Tech, Inc.
Bellevue, Washington

WILLIS L. KEMPER
Roy F. Weston, Inc.
Seattle, Washington

ABSTRACT

Cleanup personnel were faced with the management of 2,900 drums during the immediate removal action at Western Processing Company, a chemical recycling facility in Kent, Washington. After reviewing the data needs and costs of several disposal options, management made the decision to composite the drum contents for disposal. To perform this safely, chemical characterization and bench-scale compositing were performed prior to onsite compositing. Effective field methods to characterize and composite hazardous materials are presented in this paper based on this practical experience.

DECISIONMAKING BY WESTERN PROCESSING CLEANUP MANAGEMENT

Effective use of Superfund monies was a prime consideration during the emergency cleanup of the Western Processing site in Kent, Washington. Western Processing, a chemical recycling operation since 1961, was found to be contaminating a shallow groundwater aquifer and a surface stream running adjacent to the site. During an initial survey of the site, cleanup management discovered 2,900 drums containing a wide variety of materials. Inventory records and drum labels indicated the presence of hydrochloric, nitric, sulfuric, chromic, phosphoric, and hydrofluoric acids, sodium hydroxide, formaldehyde, trichloroethylene,

ink, acetone, freon, methyl ethyl ketone, isopropyl alcohol, zinc oxide, perchloroethylene, methanol, xylene, methylene chloride, toluene, and several other hazardous substances.

Based on the results of the initial survey, site management identified several cleanup options to deal with the Western Processing site. These options included total removal of all materials onsite, partial removal of the material determined to be hazardous, or stabilization of materials onsite to prevent migration offsite. The partial removal option was determined to be the best solution to the immediate problems at Western Processing.[1] By selecting partial removal, site management had to decide which materials to remove, how to remove the materials, and where to dispose of the materials. To identify the potentially hazardous materials, site management decided to chemically characterize each drum on the site. Materials displaying chemically dangerous properties would be removed from the site. Materials that did not pose a particular hazard would be left onsite for possible remedial action later.

Cleanup management also identified the transportation and disposal options for the hazardous materials located at the site. Hazardous materials could either be removed intact in drums or compatible materials could be composited in an onsite batching procedure and transported to a disposal site via tank trucks. Management decided that onsite compositing was the most cost effective method for removing many materials from the site. Generally, a larger volume of material per transport vehicle can be removed in a composite tank or tank truck than on a flatbed truck carrying drums. Onsite compositing reduced disposal costs because disposal sites charge less to accept materials from tank trucks than materials in drums.

CHEMICAL CHARACTERIZATION

When a large number of drums containing different materials are discovered on a site, onsite compositing is a cost effective means to remove the materials from the site. In order to composite the drum materials, the chemical characteristics of the materials in each drum must be determined. Chemical characterization is performed to identify the hazardous materials onsite and to determine which materials are chemically similar for onsite compositing If chemically dissimilar materials are composited, violent reactions could occur during mixing Characterization is accomplished by testing drum contents with portable field instruments. Since only general chemical properties are needed to determine which materials are compatible, a complete chemical analysis of the material from each drum is unnecessary. In addition, testing drum contents with field instruments is faster and less costly than laboratory analysis.

Several different characterization schemes have been proposed that require various field tests to characterize materials onsite.[2,3] Some of the possible field tests include

- radiation
- organic vapors
- pH
- oxidation potential
- reduction potential
- flammability
- combustibility
- solubility
- water reactivity
- flash point

In addition, some existing compatibility schemes test for specific chemicals or chemical groups such as polychlorinated biphenyls (PCBs), cyanides, sulfides, and chlorides.

RECOMMENDED TESTS AND PROCEDURES

Based on the experience gained at the Western Processing site, the following characterization scheme is recommended to chemically characterize drum contents. The information obtained from the recommended procedure includes measures of organic vapors, radiation, pH, flammability, water reactivity, and oxidation potential for each drum.

Prior to conducting the tests, all the drums on a site should be staged and opened. Organic vapor and radiation tests are conducted directly from the drums in the staging area. The other tests must be conducted on samples taken from each drum. Representative samples should be taken using glass rods and transferred to one pint glass jars A minimum of one-half pint of material is needed to complete the characterization and bench-scale compositing procedures. A characterization table is set up to perform the remaining tests. Testing stations are set up on the table so that as one test is completed, another test may be started. Two persons should work at the table at one time, with each person conducting two different tests. One person tests each sample for pH and flammability while the other person tests each sample for water reactivity and oxidation potential. Several samples may be tested at once to increase the efficiency of the procedure.

Other tests may be performed on drum samples if required by disposal site considerations. Materials containing PCBs must be identified because they may require special disposal methods. Flammables and oils should be tested for PCBs using a portable test kit or by an analytical laboratory. Since PCB tests are costly and time consuming, it is recommended that the PCB analysis be conducted on composited samples obtained during the bench-scale compositing procedure described later. Cyanide

and sulfide concentrations may be determined by testing samples with an ion meter using specific probes. These tests also require more time to perform and should be conducted on composited samples during the bench-scale compositing procedure.

The recommended testing procedures and the information obtained from each test are presented below.

Radiation and Organic Vapor Survey

Drums are staged and opened prior to the survey so that the survey can be conducted quickly. Radiation is measured by placing the probe of a radiation meter near the opening of each drum If the radiation test on any drum is positive, then the drum should be set aside to be disposed of as a radioactive material. Exposure of cleanup personnel to the radioactive material should be avoided and no other tests should be performed on the material. Organic vapors are measured by placing the probe of an organic vapor analyzer or photoionizer into the air space in each drum A high organic vapor reading from drum material indicates that the material may be flammable. All survey information should be recorded on a drum inventory or characterization data record.

pH Measurement

Transfer 100 ml of sample from the glass sample jar to a 4.5 oz heavy polypropylene cup. The pH of a sample is determined using a multiband pH paper strip. The strip is immersed in the sample and withdrawn. The bands on the paper change color dependent on the pH of the material. The paper is compared to a reference chart indicating specific colors for different pH values.

The pH of a highly colored substance such as waste ink is accomplished using a standard pH meter. A pH meter is not recommended for

the majority of the pH tests because the meter probe fouls easily and would require constant maintenance.

Measurement of pH is important, especially in determining compatibility with other materials. High and low pH materials should be segregated because of the violent reactions and possibly toxic substances released when these materials mix. The pH of a material also indicates corrosivity (pH $\leq$2 or >12), which is a concern in transportation and disposal of the material.

Flammability

Using a disposable plastic, closed-bulb pipette, transfer approximately 5 ml of material from the polypropylene cup to a disposable glass vial. Screen the sample in the vial for explosive hazard by placing an ignition source just inside the top of the vial. If the vapors generated by the material at ambient temperatures ignite, the material should be considered flammable and/or potentially explosive. Vapor ignition will be evident by a flame flash at the top of the vial, generally followed by the extinguishing of the ignition source. An electric match, butane lighter, or pilot light are acceptable as an ignition source.

Samples with vapors that do not ignite at ambient temperature should be tested for flammability. Several vials are placed in a rack, covered with loose plastic caps, and immersed in a water bath at a constant temperature of 100°F. Once the materials in the vials have reached the temperature of the water bath, the plastic cap is removed from each vial and an ignition source immediately is placed at the top of the vial. If the vapors from the material ignite, the material is flammable. Materials determined to be nonflammable are further tested

for combustibility by raising the temperature of the water bath to 150°F and repeating the ignition test. Materials whose vapors ignite between 100°F and 150°F are considered combustible. Materials whose vapors do not ignite prior to 150°F are considered nonflammable and noncombustible This procedure is especially efficient when several samples are heated at the same time.

The determination of the flammability or combustibility of a material is important for hazard determination and for transportation and disposal requirements. Flammable and combustible materials present a greater hazard than nonflammable or noncombustible material. In addition, flammable and combustible materials must be properly placarded on transport vehicles. This test procedure may be adjusted if a disposal site has limitations concerning material flash points. Many disposal sites cannot accept materials that exhibit a flash point under a specified temperature. In the flammability test, the water bath temperature may be adjusted to limiting temperatures required by the disposal site. If vapors from the samples ignite at or below this limiting temperature, than another disposal method or disposal site must be found. Most materials with a low flash point may be disposed of by incineration.

Water Reactivity

Place 100 ml of distilled water in a 4.5 oz heavy polypropylene cup. Note the temperature of the water and continue to monitor temperature throughout the procedure. Add 2 ml of sample from the pH measurement cup to the distilled water with a plastic disposable, closed-bulb pipette. If the temperature of the resulting mixture increases, then the material is considered water reactive. Prior to

conducting the test, it is imperative to confirm that the distilled water and sample are at the same initial temperature.

Water reactivity is determined for several reasons. The Resource Conservation and Recovery Act defines a material as hazardous if it is reactive with water. The probability that a material on a site will contact water at some time is high, especially material in drums that have deteriorated.

Oxidation Potential

Place 50 ml of 0.001 Normal ferrous ammonium sulfate solution into a 4.5 oz heavy polypropylene cup. Measure the cell potential of the ferrous ammonium sulfate solution using a millivolt (mV) meter with a platinum sensing electrode and standard reference electrode. Remove the electrodes and add 50 ml of sample from the pH measurment cup to the ferrous ammonium sulfate solution. Mix the solutions and let stand for one minute. Measure the change in cell potential of the mixture with the millivolt meter. A change of 50 mV in the positive direction indicates the presence of an oxidizing agent in the sample Ferrous ammonium sulfate is used in this procedure because it is easily oxidized and the difference in oxidation potential may be measured with the millivolt meter.[4]

If the sample is organic in nature, the mixture may separate into layers. The organic layer of the mixture should be drained off and only the aqueous layer of the mixture is tested. It is important to keep the probes away from organic materials because they will foul and require constant maintenance.

This test is performed because of the violent reactions that take place when an oxidizing agent comes in contact with easily oxidized

material If an oxidizing material is found on a site, it should be segregated from other materials on the site and disposed of separately. In addition, transportation considerations require that oxidizing agents be labelled as oxidizers when transported.

CLASSIFICATION OF CHARACTERIZED MATERIAL

Once all samples have been field tested, the analytical results need to be compiled, preferably by computer. For each sample the following information should be identified physical state (solid or liquid), radioactivity, oxidation potential, pH, flammability, water reactivity, organic vapor concentration, and any specific analytical results required by the disposal site. PCB concentration should be added following the bench-scale compositing procedure. Based on the data, the characterized samples can be grouped into fairly distinct classes for compositing and/or for disposal. These categories are radioactive, PCB concentration equal to or greater than 500 ppm, PCB concentration between 50 and 500 ppm, solids, corrosive oxidizers, noncorrosive oxidizers, corrosive acids, corrosive bases, flammables, water reactives, and nonhazardous (Table 1). Additional disposal site analytical requirements may add categories or modify these basic classifications.

Should no further field testing be desired, these classifications allow drums to be segregated for transportation considerations (i.e. to avoid shipping corrosive acids and bases on the same truck). Similarly, the acceptability of materials classed in these categories can be readily identified in regard to the requirements and capabilities of different disposal sites. However, on hazardous waste sites with a large number of drums, this classification scheme lends itself to determining if chemically similar materials within a particular category can

Table 1. Chemical Characterization Classes

Classification	Radiation	PCB	Solid	Oxidation Potential	pH	flammability	Water Reactive
		SAMPLE CHARACTERISTICS					
Radioactive	Yes	*	*	*	*	*	*
PCB ≥500 ppm	No	≥500 ppm	*	*	*	*	*
PCB 50 ≤ <500 ppm	No	50≥ and <500 ppm	*	*	*	*	*
Solid	No	<50 ppm	Yes	*	*	*	*
Corrosive Oxidizer	No	<50 ppm	No	≥50 mV	0-2	*	*
Noncorrosive Oxidizer	No	<50 ppm	No	≥50 mV	3-14	*	*
Corrosive Acid	No	<50 ppm	No	<50 mV	0-2	*	*
Corrosive Base	No	<50 ppm	No	<50 mV	12-14	*	*
Flammable	No	<50 ppm	No	<50 mV	3-11	Yes	*
Water Reactive	No	<50 ppm	No	<50 mV	3-11	No	Yes
Nonhazardous	No	<50 ppm	No	<50 mV	3-11	No	No

* Result irrelevant; prior category has greatest importance

be composited for more economical shipping and disposal Furthermore, should it be desirable to ship commercially-viable products to a recycling facility rather than a disposal site, this classification method will provide general evidence to confirm or deny the site operator's labelling of product materials. At the Western Processing site, this categorization allowed the culling of drums labelled as containing viable products, when in fact the chemical characteristics identified through field testing indicated that the materials in many drums could not possibly be the products specified by the labels.

BENCH-SCALE COMPOSITING

Bench-scale compositing of similar materials is a necessary step prior to onsite compositing of the contents of drums for several reasons. First of all, it provides a general confirmation of the chemical characterization classification of different samples. It also determines the compatibility of materials within a given classification. Finally, it provides a safety margin for subsequent onsite compositing by eliminating incompatible materials from compositing consideration and by identifying possible reactions to expect with full scale compositing.

Not all of the categories in the classification scheme should be considered for compositing. Classes such as radioactive, PCB containing, solid, corrosive oxidizer, and noncorrosive oxidizer probably should be shipped for disposal in intact drums on flatbed trucks. Compositing of corrosive acids or corrosive bases is not always advisable. If compositing is attempted, special care should be taken because of the violent reactions which can occur, particularly when large scale compositing is attempted later.[1] The prime candidates for compositing are flammables, water reactives, and, if necessary, the nonhazardous class.

The basic concept for bench-scale compositing is to take a small quantity of material from samples in the same category, mix them one sample at a time, and observe any reaction. Temperature rise and the generation of gases are the primary reactions to watch for. Reactive samples should be identified and excluded from later onsite compositing. When hundreds of samples are involved in the compositing process, a portion of the composited material should be set aside when moderate quantities have been mixed. This minimizes the possibility that due to a reaction with a later addition, the entire composited quantity has to be discarded, and the entire process redone. The following procedures were implemented during the Western Processing site cleanup, worked well, and are recommended for other sites.

All drum samples falling within the chemical classification to be composited were staged on a table. A small cup with a thermometer was set up behind a clear plastic shield. A plastic disposable, closed-bulb pipette was used to draw off a small (3-5 ml) representative aliquot from each sample bottle to be placed in the mixing cup Careful recording was made of each sample added to the batch. As each subsequent aliquot was added to the mixing cup, the temperature was monitored. If a temperature increase of over 10°F was detected, the added material was considered to be reactive. The selected temperature change was chosen on the advice of the EPA Environmental Response Team. Any material which exhibited reactivity with the batch was set aside and identified as a drum to be segregated onsite and disposed of separately. Once a reaction was noted, the tainted batch was discarded, the nonreactive samples were remixed, and the compositing process was continued.

After 10-15 samples had been mixed successfully, half the mixture was set aside in a labelled flask as a backup. The remaining mixture

continued to serve as the compositing medium. Another 10-15 samples were added one at a time and examined for any reactivity with the mixture. If a reaction occurred, that particular sample was removed from consideration for onsite compositing, and the entire mixture was discarded. Either all or a portion of the backup mixture (depending on the available quantity) was placed in the mixing cup, aliquots of the nonreactive samples in the latest group were remixed, and compositing was continued. Again, once 10-15 samples were successfully composited, half of the composited material was added to the mixture in the backup flask. These procedures were maintained until all samples in the group had been tested This same bench-scale approach was then used to batch other groups and individual products. The final results of the bench-scale compositing were lists of batchable drums within each group and a list of drums to be shipped offsite individually.

At Western Processing several other considerations arose concerning disposal site requirements. The presence of cyanide was a concern for one disposal site, so a cyanide probe was set up and added as a step in the compositing process. Due to the sensitivity of the probe it was highly desirable to avoid having to test every sample. Instead, once 10-15 samples had been composited in the mixing cup, the mixture was tested for the presence of cyanide. If a positive response greater than 10 ppm (the disposal site level of concern) was noted, each of the samples present in the mixture were tested individually. Samples above the threshold for cyanide were excluded from onsite compositing consideration. It was recognized that sulfides present would interfere with the cyanide test, however, because the procedure to distinguish between cyanide and sulfide was sensitive and time consuming, it was decided to

simply be conservative and assume the cyanide probe reading was due solely to cyanide.

PCBs and flash points were also of concern in the compositing process. Although PCB analyses had been run onsite by the EPA Environmental Emergency Response Unit's Mobile Laboratory from Edison, New Jersey, for each of the individual samples, an additional PCB analysis was performed on the final batch mixture for each of the classifications that were composited. Similarly, a closed-cup flash point measurement unit was set up and all final mixtures also had their flash points determined.

ONSITE COMPOSITING

Onsite compositing is performed with drums that have previously been determined to be compatible during the bench-scale compositing procedure. While the bench-scale testing is a simulation of onsite compositing, large scale mixing of materials could promote reactions not observed during the bench-scale procedures. In addition, if the samples used in the bench-scale compositing procedure are not representative of the drum contents, an incompatible material may be added to the composite, causing a reaction. To decrease the magnitude of possible reactions, precautions should be taken when compositing drums. Drums should be composited in the same order as during the bench-scale compositing procedure. Drum materials should be composited slowly and the mixing vessel continuously monitored. If the temperature in the mixing vessel increases or vapors are released, compositing should be discontinued until the materials have completely reacted.

Ideally, a large compatibility chamber or open tank should be used as a reaction vessel. Tank or vacuum trucks may be used if an open vessel is not available. If trucks are used however, they should be

monitored carefully during compositing because violent reactions could damage these trucks. The mixing vessel must be made of materials that do not react with the drum contents. Corrosive materials should be mixed in rubber-lined tanks while organics are best composited in metal tanks.

Drum contents are added to the mixing vessel using a drum grappler, hose and pump, or vacuum truck. A drum grappler is the best method of emptying drums because workers are less likely to contact drum materials.

Once all the compatible materials of one classification are composited, samples of the composite may be taken for further analysis. Since most disposal sites require that the flash point of the composite be measured, this test may be performed on the composite sample. The composite sample may also be used to identify the specific chemicals that were onsite by having a laboratory analyze the sample

SAFETY CONSIDERATIONS

Personnel safety is an important consideration during any site cleanup. The procedures described for characterization, bench-scale compositing, and onsite compositing must be conducted so that exposure to hazardous substances is prevented. Since personnel performing these procedures are at risk to exposure, appropriate respiratory and skin protection must be provided. Respiratory protection for characterization, bench-scale compositing, and onsite compositing should be provided by a back-mounted gas mask or full face respirator equipped with a combination particulate, organic vapor, and acid gas canister. This level of protection is required because of the highly volatile or toxic gases that may be released during these procedures. A self contained breathing apparatus should be used if the characterization procedure is

conducted inside or in a poorly ventilated area. If any of these procedures are conducted onsite, personnel must follow the appropriate level of respiratory protection set by the site safety officer. Ambient air monitoring should be conducted during the characterization and compositing procedures. Monitoring will determine if and to what extent these procedures are contaminating the ambient air. In addition, the level of respiratory protection may be upgraded if contaminants in the ambient air are determined to be too high.

Skin protection should be provided by a hard hat or chemical resistant hood, plastic face-shield, chemical resistant or plastic coated coveralls, rubber apron, inner and outer chemical resistant gloves, and steel-toed, steel shank rubber boots. This equipment provides splash and spill protection from possibly corrosive and toxic materials. A decontamination area should be provided so that workers may dispose of soiled protective equipment and completely wash themselves. Emergency decontamination procedures should be set up to be followed if a worker becomes grossly contaminated.

Due to the exothermic nature of most chemical reactions, fire is a real danger during characterization and compositing. Chemical fire extinguishers should be readily available to put out small fires. Since large fires could be generated during onsite compositing, local fire departments should be notified prior to full scale compositing.

SUMMARY

Onsite compositing is an economical method of handling hazardous materials from a waste site. Transportation and disposal costs are reduced when drum materials are composited rather than removed intact. In order to perform onsite compositing, drum materials must be chemically

characterized. Characterization identifies the hazardous materials on a site and determines which materials may be composited. The characterization procedure is flexible and may be altered to perform other tests as required by a disposal site. A bench-scale compositing procedure is performed to ensure that drum materials with similar chemical properties are compatible and to minimize problems during onsite compositing.

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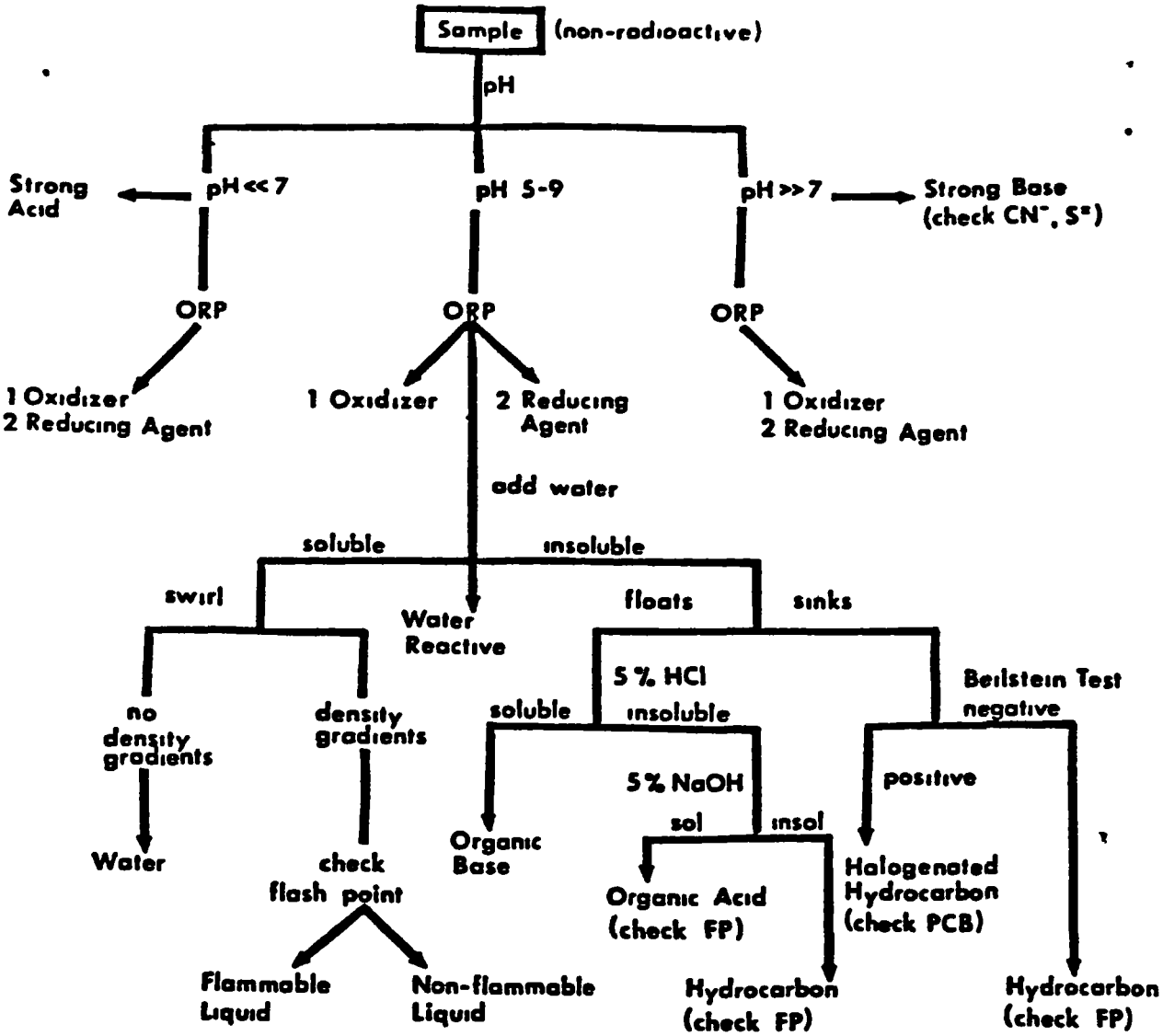
PART 3

COMPATIBILITY TREE



SCREENS FOR: 1 Strong Acids
2 Strong Bases
3 Oxidizers
4 Reducing Agents
5 Cyanides & Sulfides
6 Water Reactives
7 Flammable Liquids
8 Halogenated Hydrocarbons
9 PCB's

COMPATIBILITY TEST-SITE 2

Organic vapor None

pH 5.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74° F end temp 74° F

Oxidation potential 0

Ambient temperature during testing 74° F

Tests performed by

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 2-1 at depth of 1.0 to 2.0 Feet.

COMPATIBILITY TEST-SITE 2

Organic vapor None

pH 5.8

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 2-10 at depth of 0-10 Feet

COMPATIBILITY TEST-SITE 10A-

Organic vapor None

pH 4.3

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 10-1 at depth of 0.1 to 1.0 Feet.

COMPATIBILITY TEST-SITE PDA - 12-2

Organic vapor Minor

pH 8 4

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°c end temp 22°c

Oxidation potential -108 7

Ambient temperature during testing 21°c

Tests performed by

James C Staves II

JAMES C STAVES, II
Biologist

Note: Sample taken From Boring 12-2 at depth of 8-10.5 Feet

COMPATIBILITY TEST-SITE PBA 12-6

Organic vapor None

pH 10.0

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°C end temp 22°C

Oxidation potential -163.8

Ambient temperature during testing 21°C

Tests performed by

James C Staves II

JAMES C STAVES, II
Biologist

Note: [redacted] Sample taken From Boring 12-6 at depth of 0-0.7 Feet

COMPATIBILITY TEST-SITE PBA -12-16

Organic vapor None

pH 10.0

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°c end temp 22°c

Oxidation potential -114.1

Ambient temperature during testing 21°c

Tests performed by

James C Staves II

JAMES C STAVES, II
Biologist

Note: Sample taken From Boring 12-16 at depth of 0-10 Feet.

COMPATIBILITY TEST-SITE 17

Organic vapor None

pH 6.5

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxid tion potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 17-2 at depth of 0 to 1.0 Feet.

COMPATIBILITY TEST-SITE 20B

Organic vapor None

pH 5.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 20-12 at depth of 0 to 1.0 Feet.

COMPATIBILITY TEST-SITE 23A

Organic vapor None

pH 6.9

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74° F end temp 74° F

Oxidation potential 0

Ambient temperature during testing 74° F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 23-1 at depth of 5.0 to 8.0 Feet.

COMPATIBILITY TEST-SITE 26

Organic vapor None

pH 9.7

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 26-9 at depth of 0 to 0.2 Feet

COMPATIBILITY TEST-SITE 29-2 1.0-2.0
Jar 2.0

Organic vapor None

pH 8.3

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 240.9

Ambient temperature during testing 74°F

Tests performed by

James C Staves II

JAMES C STAVES, II
Biologist

Note: Sample taken From Boring 29-2 at depth of 1.0 to 2.0 Feet

COMPATIBILITY TEST-SITE 29-28 0-10
Jar 1

Organic vapor None

pH 8.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 352.7

Ambient temperature during testing 74°F

Tests performed by

James C Staves II

JAMES C STAVES, II
Biologist

Note: Sample taken From Boring 29-28
at Depth of 0 to 1.0 Feet

COMPATIBILITY TEST-SITE 31

Organic vapor None

pH 7.7

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Boring 31-8 at depth of 0 to 0.4 Feet.

COMPATIBILITY TEST-SITE 34

Organic vapor None

pH 5.2

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by

Richard G Hunter

RICHARD G HUNTER
Environmental Specialist

Note: Sample taken From Sediment Sample SD-1, the pond Sediment From the North Shore.